

PRODUCTION

EDITION

for Manufacturers of Chemicals for Agriculture

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MODERN PLANT for manufacturing pesticides and fertilizers is seen above in aerial view of Agsco, Inc., Grand Forks, N.D. The firm makes and distributes agricultural chemical products throughout the northwest. See story on page 4.

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ROLE OF DILUENTS . . .

Knowing Physical and Chemical Properties of Inert Materials Vital to Pesticide Formulators

Pesticidal Diluents Exert Broad Influence On Final Performance Of Toxicant in Field

INERT INGREDIENTS in a pesticide formulation are defined as being "non-toxic", but as components of pesticide formulations contribute a great deal to the mixture's ultimate effectiveness.

The very function of carriers and diluents implies that they will dilute the active poison to workable levels and carry or distribute the toxic material to the pest in usable form. Therefore, sound practices in the formulation of pesticides require careful selection of inert ingredients. They should have no harmful effect on the toxic materials, but rather, they should enhance the latter's effectiveness.

Broadly speaking, the term "inert ingredients" includes surface active agents, spreaders, stickers and adjuvants, as well as carriers and diluents (gaseous, liquid, and solid). Our discussion will be restricted to solid carrier-diluent materials, and moreover will deal principally with non-metallic mineral types because of their predominance in the pesticide industry.

The principal carrier and diluent classifications in current use are those having to do with (a) min-

eral or natural sources, (b) chemical properties, and (c) physical properties. The mineral origins of these materials are rather readily definable. However, there exists an unfortunate lack of standardization of methods used to determine chemical and physical properties which confuses the significance and impairs the utility of these two classification systems.

This state of confusion is due in part to the fact that the significance of these properties is most evident in finished formulations which can be evaluated only in terms of results in the field. A review of the literature concerning the use of carriers and diluents turns up many conflicting facts and opinions as to why one material or another shows greater or less efficiency.

Probably the most complete description of mineral sources is that worked out by Watkins and Norton, Cornell University. "Properties of Commercial Sources of Insecticide Dust Diluents and Carriers." With their permission it is reproduced below:

MINERALS

- A. Elements
 - 1. Sulphur
- B. Oxides
 - 1. Silicon
 - a. Tripolite
 - b. Diatomite
 - 2. Calcium

- a. Calcium Lime
- b. Magnesium Lime
- c. Unidentified

- C. Carbonates
 - 1. Calcite
 - 2. Dolomite

- D. Sulphates
 - 1. Gypsum

- E. Silicates
 - 1. Mica
 - 2. Talc
 - 3. Pyrophyllite

- 4. Clays
 - a. Montmorillonite Group
 - (1) Montmorillonite
 - (2) Saponite
 - (3) Nontronite
 - (4) Beidellite
 - b. Kaolinite Group
 - (1) Kaolinite
 - (2) Nacrite
 - (3) Dikite
 - (4) Anauxite
 - c. Attapulgite Group
 - (1) Attapulgite
 - (2) Sepiolite
 - d. Unidentified

- F. Phosphates

- 1. Apatite

- G. Indeterminate

- 1. Pumice

The mineral origin of a carrier and diluent is significant in that by this identification certain physical and chemical properties are implied. In order to ascertain suitability for use with pesticides, however, consideration must be given to the impurities present, and the processing the raw mineral receives prior to its use. In other words, there may be appreciable differences among products from the same general mineral source.

Another group of naturally derived diluent materials is described by Watkins and Norton as follows:

BOTANICAL FLOURS

- a. Soybean Flour
- b. Tobacco Flour
- c. Walnut Shell Flour
- d. Wheat Flour
- e. Wood Flour

Chemical Properties

- Chemical Analysis
- pH
- Compatibility

Chemical analyses of diluents may be misleading since the results are usually expressed as oxides of the elements present; whereas in most instances the constituents of the diluent are present as chemical or crystalline complexes which can be identified only by X-ray patterns. Thus far, no very useful correlation has been found between the chemical nature of minerals and their utility with pesticides.

The pH (indicated hydrogen ion concentration) of diluents is a much-

discussed chemical property and is generally thought of as a measure of suitability of a material for use with alkali (or acid) sensitive chemicals. There is little or no information available as to the source or nature of the indicated hydrogen ion concentration of various carriers and diluents. Such information is necessary before reliable judgment can be exercised as to the reactivity of a diluent.

Under the term "compatibility" are grouped miscellaneous empirical chemical effects of one ingredient upon another in pesticide formulations. Information is generally meager and speculative as to the precise nature and cause of the behavior of carriers and diluents. Sometimes stabilizers are recommended in formulating the more sensitive active ingredients.

Claims are sometimes made to the effect that certain diluents increase the toxicity of chemicals. This may be possible; however, complete inertness is a virtue much to be sought for in carriers and diluents.

This is a list of the more significant physical properties of carriers and diluents:

Physical Properties

Sorptivity	Wettability
Flowability	Suspensibility
Dustability	Abrasiveness
Density	Moisture Content
Particle Size	

No group of characteristics means more in a formulator's appraisal of a carrier or diluent than its physical properties. Mineral source may be examined for precise identification, and chemical composition can be utilized for the same purpose, but physical characteristics really tell the story when it comes to usefulness. The full significance of the diluent's intrinsic properties is most apparent when it is realized that in most finished field strength preparations the diluent constitutes from 80% to over 95% of the entire formula.

Moreover, demands upon inert ingredients become increasingly stringent. An example of this is the introduction of chlorinated hydrocarbons and other organic chemicals in the pesticide field.

This development alone has greatly changed the industry's concept of necessary properties for carriers and diluents. The formulation of such chemicals to field strength dusts and wettable powders posed new problems which arose from the physical nature of the chemicals themselves. Most of them are either sticky, viscous liquids or low-melting wax-like solids.

To process these chemicals into dry, lump-free compositions, it is necessary to employ carriers possessing high sorptive capacity. Adequate sorptive capacity is also essential to economical production rates in both

Turn to **DILUENTS** page 29



EVALUATION FOR PESTICIDE USE—This muffle furnace is used in the determination of volatile matter in pesticide carrier. The furnace operates in a range of 200 to 2500° F. and is accurately controlled. Such determinations are of considerable value to pesticide formulators in calculating types of material for specific uses. (Photo and article courtesy Minerals & Chemical Corp., Menlo Park, N.J.)

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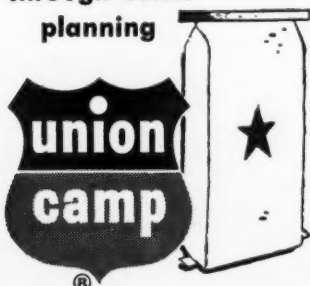
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North Dakota Plant Makes Both — pesticides and plant

A NORTH DAKOTA plant, Agsco, Inc., has been operating at Grand Forks for a number of years, making fertilizers, insecticides and herbicidal dusts. An unusually tidy plant, Agsco's manufacturing and storage facilities are housed largely in steel buildings. Its office, shown below, is headquarters for the firm's operations.

Manager of the company is M. S. Buckley who has described some of the firm's present operations and has outlined future plans soon to be under way. In the latter case, Agsco expects to erect

a plant for the formulation of liquid insecticides and herbicides soon. Such a plan has been under consideration for some ten years, Mr. Buckley says.

Larry Brown, president of the company, states that the question was not whether Agsco would build such a plant, but rather, when it would fit most appropriately into the natural growth pattern.

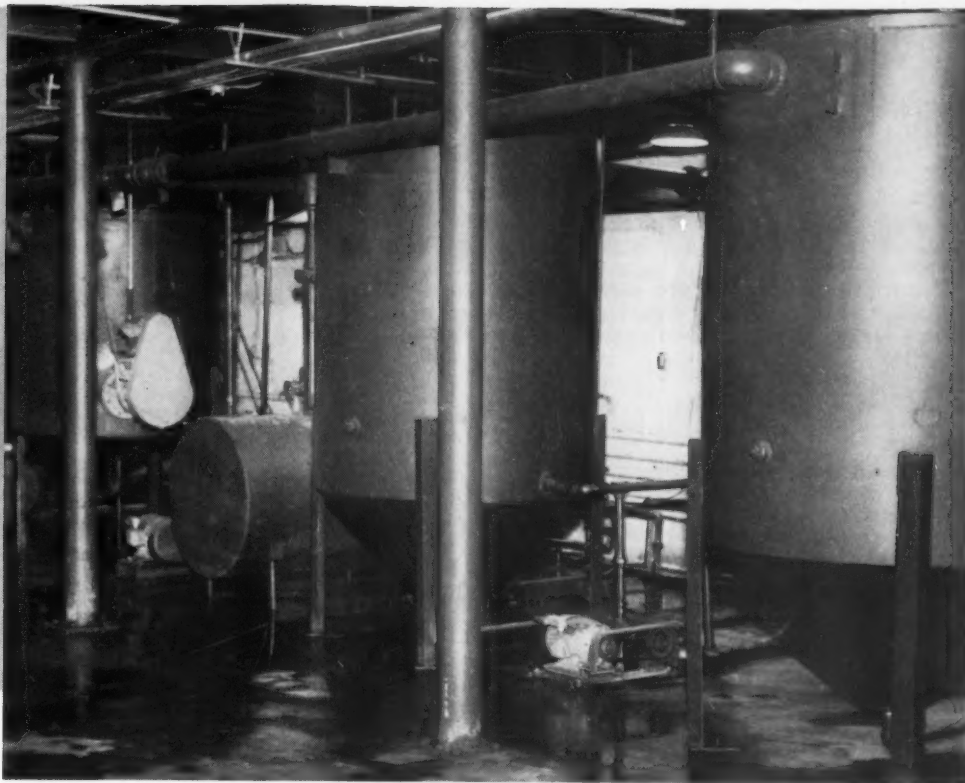
The present facilities were erected during the latter part of 1957 and the early months of 1958.

The formulating plants went into production in May, 1958, Mr. Buckley reports, and later in the year two warehouses were constructed. Each of these units is 50 ft. by 200 ft. in size, and their completion marked the end of the major building program.

The company originally started in the middle thirties as a sideline to the Flaatt Farm enterprises with Mr. Brown as the managing partner. In 1945 Mr. Brown bought out the Flaatt interests and a new partnership was formed with C. W.



NORTH DAKOTA INSTALLATION—Views on these two pages show some of the production facilities of Agsco, maker of fertilizers and pesticides for distribution in the northwest. At left is aerial view of plant proper. Black-roofed building houses fertilizer plant. The long white building parallel to it houses the formulating plants; the left end devoted to insecticides, the right for herbicides. The steel buildings, left to right, are the insecticide warehouse, fertilizer warehouse and herbicide warehouse. In upper right is steel building fabrication shop.



foods

Sande under the name of Agricultural Supply Co.

In 1949 three separate corporations were formed—AGSCO Chemicals, Inc., AGSCO Steel Buildings, Inc., and AGSCO Seeds, Inc., with the partnership continuing to operate the retail stores. During this time each of the three corporations did its own distribution.

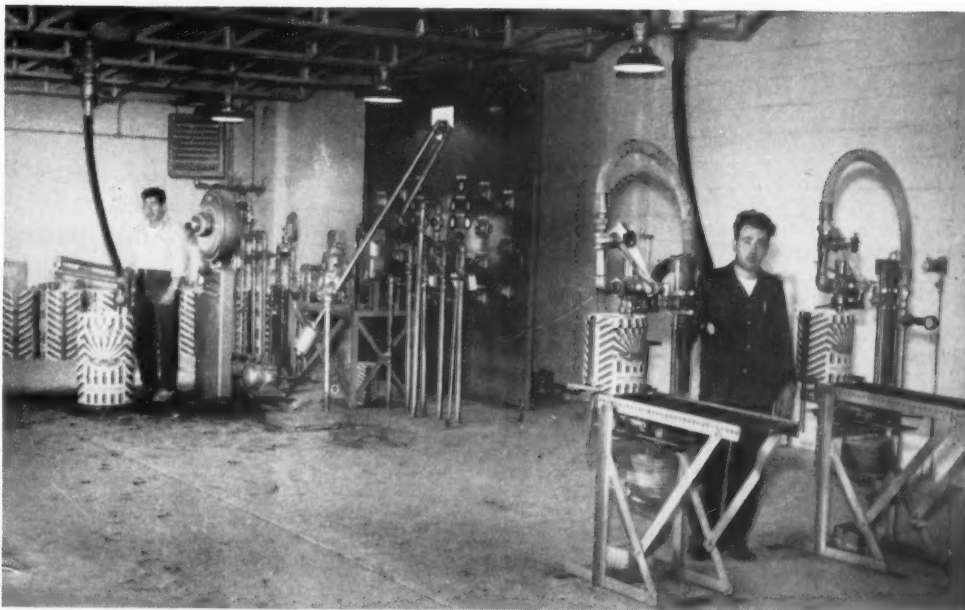
In 1955 a fourth corporation, AGSCO Distributors, was formed and the methods of distribution changed so that the three original corporations, Seeds, Chemicals and Steel Buildings, are now in the capacity of manufacturers and processors with the entire line being handled by AGSCO Distributors. There are presently eleven distribution points with stores and warehouse facilities at Grand Forks; Moorhead, Minnesota; Crookston, Minnesota; Hallock, Minnesota; St. Hilaire, Minnesota; Jamestown, North Dakota; Bismarck, North Dakota; Dickinson, North Dakota; Minot, North Dakota; Devils Lake, North Dakota, and Grafton, North Dakota.

Each distribution point has a manager and sales personnel working a definite territory. The sales are made through dealers and in some cases, direct, varying somewhat between, and within, territories. Basically, the firm's products are for the farm: Seeds, insecticides, herbicides and steel buildings. "We do not go in for small package lines," Mr. Buckley comments.

"We have developed a number of our own corn hybrids at our corn plant in Moorhead, Minn.," he continues. Other seeds are processed in Grand Forks. The company makes pelleted fertilizer in the Grand Forks plant, and is presently converting that plant to a continuous system of ammoniation and granulation with a capacity of 20 tons an hour.

As to the capacity of the new Canadian

Turn to **PESTICIDE PLANT** page 13



PRODUCTION CHIEFS—At left are M. S. Buckley, manager; Larry Brown, president, and C. W. Sande, vice president and assistant general manager of Agsco. Under them is the firm's main office in Grand Forks. At the right are interior shots of the plant. Top photo: basement of herbicide plant showing mixing tanks. Middle: First floor of herbicide formulating plant showing central control panel. All equipment may be controlled from this compact working area. Below: Interior view of the insecticide warehouse as seen from the formulating plant. The building measures 50 ft. by 200 ft.

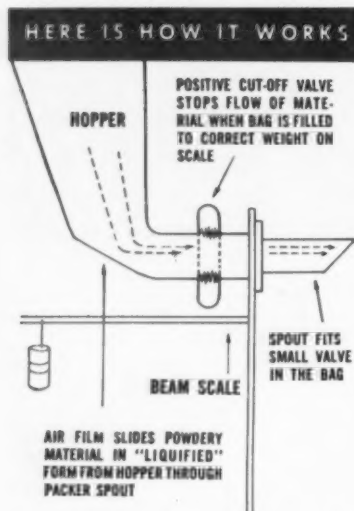


What's New?

Additional information is available about new products, new services, and literature described in this department. Circle the numbers of items on which you desire more information, fill in your name, your job title, your company's name and address on one of the cards. Then clip it out of the page and mail. No postage is necessary. The second card is for use of your fellow-production man who might also wish to send for additional information.

No. 9016—Valve Bag Packer

The fluidizing air principle of conveying powdery and free flowing materials is employed in the new Air-Pac valve packer introduced by the



E. D. Coddington Manufacturing Co. The unit fills standard valve bags from 20 to 100 lb. No moving parts are used, the company says, and no motor is required. The packer is ready to operate when connected with a 110 volt AC service and to standard low capacity air compressor sys-

tem. A built-in scale provides weight control and shuts off the packer automatically when desired weight is reached. Check No. 9016 on the coupon and mail for details.

No. 9019—Booklet on Materials Handling

Tote System, Inc., announces the availability of a 20-page, illustrated, full-color booklet on the use of the Tote System of bulk materials handling. The booklet describes the Tote System in detail, exhibiting and explaining Tote bins, Tote tanks, Tote tilts and accessory equipment. It describes various methods of transporting the unit containers and illustrates the system's use with flatbed cars and bulk hopper cars, the company says. For copies check No. 9019 on the coupon and mail.

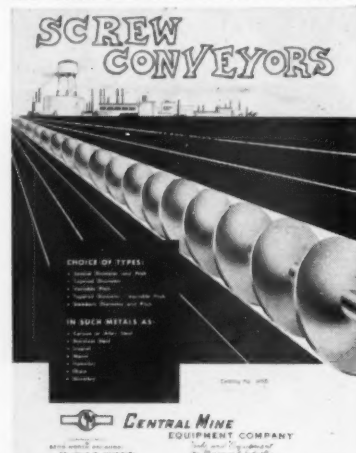
No. 9012—Moisture Balance

A new moisture balance for fast and accurate determinations of moisture content in fertilizers and a wide variety of other materials has been designed by Central Scientific Co. The makers state the new model has a built-in autotransformer which regulates voltage automatically and provides temperature control more conveniently than is the case when the autotransformer is in a separate unit. According to Central Scientific, the

balance performs both drying and weighing operations simultaneously to simplify operations. Full information on the moisture balance is available. Check No. 9012 on the coupon.

No. 9021—Screw Conveyors

Central Mine and Equipment Co. offers new literature describing custom fabricated screw conveyors for the chemical and other industries.



Fabricated of such metals as stainless, Inconel, Monel, Hastelloy, Illium, and Nitralloy, these conveyors are said to eliminate problems created in conveying, mixing and blending bulk materials having abrasive or corrosive qualities. The conveyors can be obtained in any diameter and pitch, the makers state. Also available are screw conveyors having tapered diameter, variable pitch, or a combination of these. Standard diameter and pitch screw conveyors are also available. Check No. 9021 on the coupon.

No. 9023—New Products Folder

A brochure designed as a file folder and containing 37 Prater products has been announced by Prater Pulverizer Co. The folder illustrates and describes the products and includes



descriptions of Prater engineering services, research, development, design and production. The brochure is called CL-159. Copies may be obtained by checking No. 9023 on the coupon and mailing to this publication.

No. 9014—Pump

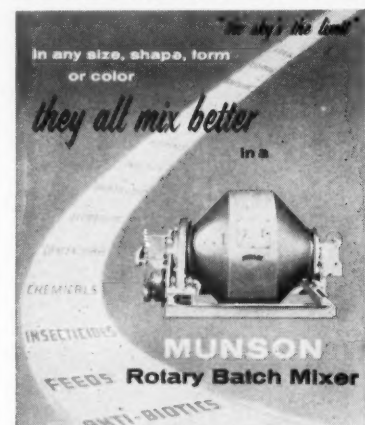
Descriptive literature on its line of Peerless pumps is available from the Peerless Pump Division, Food Machinery & Chemical Corp. Designated as "Peerless Type A" pumps, the units offered will handle water and other non-abrasive liquids in quantities up to 70,000 gpm., the makers state. The new bulletin has cutaway sectional views and cross-section drawings that describe the pumps in detail. Also included is complete dimensional and performance data. A detailed page of sample specifications is also included. For a copy of the bulletin check No. 9014 on the coupon.

No. 9022—Research Chemicals

A new edition of the catalog, "Research Chemicals from Dow," listing more than 250 compounds that may be used in new product development work, has been announced by the Dow Chemical Co. The book includes approximately 120 new compounds not listed previously in the first edition, which appeared last year under the title, "Lookin' for Somethin'?" The catalog presents a wide variety of materials currently available in limited quantities from Dow. They range from simple inorganic products to complex heterocyclic compounds. For easy reference, chemicals are listed alphabetically within groupings and a complete index is provided. Information on each chemical includes name, formula, description, properties and size of sample that is available. Check No. 9022 on the coupon.

No. 9018—Folder on Batch Mixers

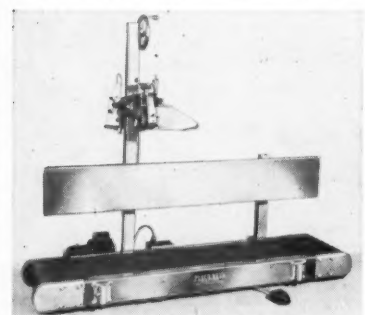
Rotary batch mixers are described in a folder recently released by the



Munson Mill Machinery Co. The four-page, two-color folder contains pictures and specifications of two types of mixers—Type 4 and Type 7. Optional features of the mixers, such as quick-open door, internal vent, air control cylinder, flush valve, strip heater and internal spray pipe, are also described. For copies, check No. 9018 on the coupon and mail to this publication.

No. 9017—Automatic Bag Closer

The introduction of an automatic bag closer has been announced by the Dave Fischbein Co. The unit, series BA, is designed so that the bags themselves start the sewing operation when they reach the sewing head, company literature states. Af-



ter the sewing is completed, the thread is cut automatically and the sewing action stops as the conveyor belt continues to move the bag. Both the belt and the sewing machine have instantaneous start-stop controls, the company said. The unit closes paper bags at the rate of 30 ft. per minute. Check No. 9017 on the coupon and mail for details.

No. 9013—Diatomite Bulletin

Mining and mineral products division of Great Lakes Carbon Corp. has

Send me information on the items marked:

- ☐ No. 9010—Emulsifiers
☐ No. 9012—Moisture Balance
☐ No. 9013—Diatomite Bulletin
☐ No. 9014—Pump
☐ No. 9015—Material Classifier
☐ No. 9016—Valve Bag Packer
☐ No. 9017—Automatic Bag Closer
☐ No. 9018—Batch Mixers

- ☐ No. 9019—Materials Handling
☐ No. 9020—Magnetic Separators
☐ No. 9021—Screw Conveyors
☐ No. 9022—Research Chemicals
☐ No. 9023—New Products
☐ No. 9024—Bulletin
☐ No. 9025—Pump
☐ No. 9026—Scrapper

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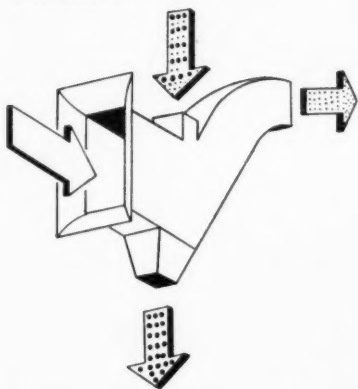
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FIRST CLASS
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released a technical bulletin on uses of diatomite mineral fillers in chemical fertilizers and insecticides, as well as numerous other applications in chemical production. The bulletin is printed in multicolor form, well illustrated and contains charts and tables helpful in calculating uses for the material. To receive a copy, check No. 9013 on the coupon.

No. 9015—Material Classifier



A "Gravitational" classifier which utilizes gravity, drag and centrifugal forces to separate dry fines from coarse materials has been announced by the Buell Engineering Co. The unit has no moving parts and can be used in classifying fertilizers, chemicals and many other materials. Material enters the classifier at the top and low velocity air is blown through it at right angles. The air stream then turns sharply upward and passes between widely spaced vanes. In doing so it collects particles smaller than a given size. For details, check No. 9015 on the coupon and mail to this publication.

No. 9020—Folder on Magnetic Separators

Jacobson Machine Works, Inc., announces a folder on Jacobson "Economy" permanent magnetic separators. The folder contains information on the various uses of magnetic separators, including permanent magnetic pulleys incorporated in the Jacobson conveyor feeders. The folder



er is the latest addition, the company said, to an assortment of folders on all of the items in the Jacobson line of hammermills and other equipment. Check No. 9020 on the coupon and mail to this publication for copies.

No. 9010—Emulsifiers

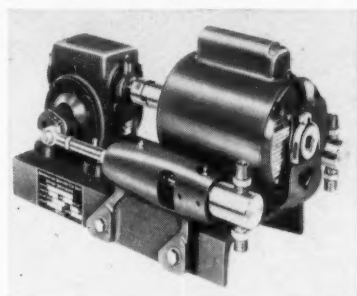
An expanded and completely revised chemicals catalog has been issued by Antara Chemicals, a sales division of General Aniline & Film Corp. The chemicals, including agricultural emulsifiers, cover a wide range.

For convenience of the reader, the catalog is divided into separate sections devoted to surfactants, organic intermediates and other categories including a section on specialty chemicals.

The 64-page book describes the composition, properties and uses of Antara products. Check No. 9010 on the coupon and mail it in.

No. 9025—Proportioning Pump

Series 100, controlled capacity pumps, introduced recently by American Meter Co., Pump Division, have been developed to handle many applications of specific volumes of fluids,



the company says. The company's Simplex models can handle capacities ranging from .65 gal. per hour to

13.10 gal. at a maximum pressure of 1,000 lb. per sq. in., the company said. Duplex models are rated at double the capacities of the Simplex models. To obtain complete details, check No. 9025 on the coupon and mail to this publication.

No. 9024—Bulletin

A bulletin entitled "Chemicals for Agriculture" has been published by Roberts Chemicals, Inc. The bulletin describes eight products currently offered by the company for the agricultural trade. Included in the list of products are fungicides, herbicides and insecticides. For copies of the bulletin, check No. 9024 on the coupon and drop in the mail box.

No. 9026—Scraper

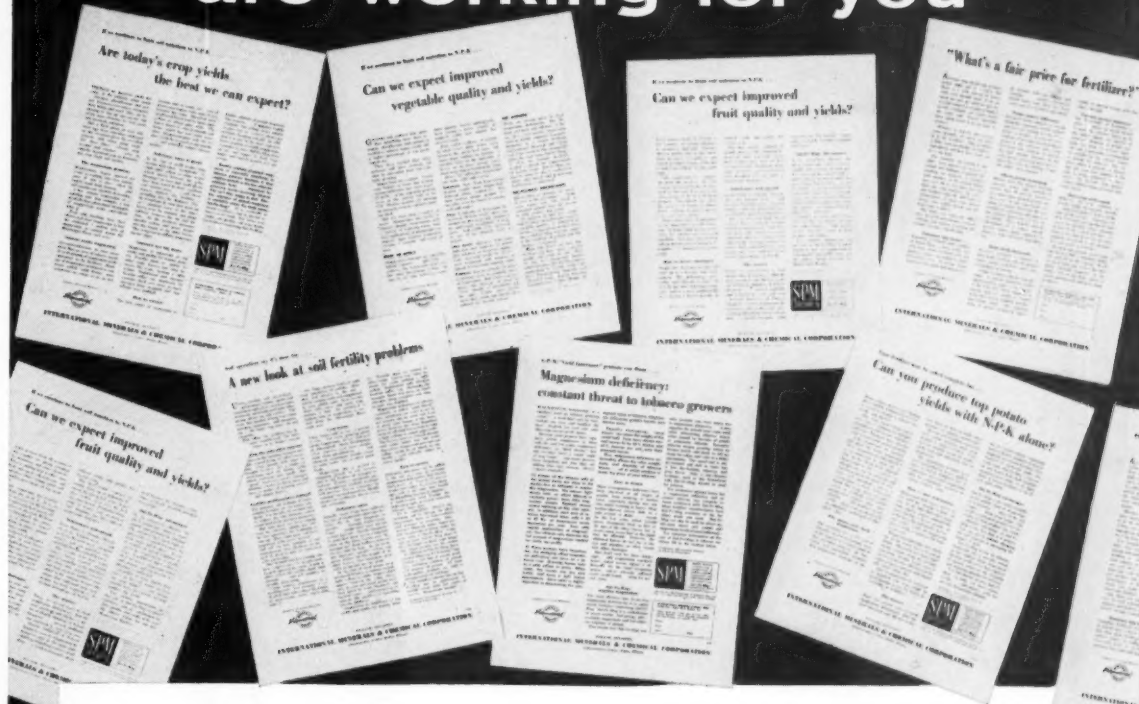
An all-aluminum hoe which can also be used as a scraper has been introduced by the Aluminum Ladder

Co. The tool can be used for removing or scraping dry chemicals, feedstuffs and other materials from vats, tanks, barges, storage bins and other containers. The hoe is lightweight,



non-corrosive, non-splintering and non-sparking. The blade is 6 in. deep and comes in 17 to 20 in. widths. For details, check No. 9026 on the coupon and mail.

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POTASH DIVISION
INTERNATIONAL MINERALS & CHEMICAL CORPORATION
Administrative Center: Skokie, Ill.

Unusual Problems Attend Mixes Of Pesticides and Fertilizers

By Robert Z. Rollins*

Chief, Bureau of Chemistry
State Department of Agriculture
Sacramento, Cal.

FERTILIZER - PESTICIDE mixtures are not a new idea, but many fertilizer manufacturers regard the current trend toward these mixtures with various feelings. Some have adopted the idea enthusiastically and believe that dual-purpose products will help to increase the sale

of fertilizers. Other firms make the mixtures reluctantly to meet local demand and still others refuse to make them at all. The latter group states that potential increases in sales do not warrant the increased problems, liabilities and expenses involved.

It is generally recognized that a manufacturer of pesticides, including pesticide-fertilizer mixtures, incurs a greater responsibility for his products than does a manufacturer of fertilizers only, and he operates in a field of much greater physical and economic hazard. Some fertilizer

firms feel that their sales staff may not be sufficiently familiar with pesticide problems to keep the firm out of trouble in the more complicated field of pest control. Increased liability insurance, pesticide registration, different freight rates for pesticides as compared to fertilizers, sales tax on the pesticide component, and other similar considerations have also been discouraging.

Some men in industry believe that these mixtures do have a prominent and permanent place, but only in certain specialty products and they expect the trend to change toward development of application equipment designed to apply pesticides and fertilizers simultaneously.

Pesticide - fertilizer mixtures and the materials used in them may present hazards during five intervals, (1) before manufacture, (2) during manufacture, (3) during storage and distribution, (4) during application, and (5) even after application.

Before manufacture, supplies of pesticides intended for use in making such mixtures should be stored with particular care in fertilizer plants and kept separate from other materials in the plant to avoid the chance of their misuse and to prevent contamination of materials and of equipment. It is of utmost importance that all containers of such pesticides be kept adequately labeled.

Special care needs to be continued in handling the materials during manufacture. It goes without saying that any spillage should be cleaned up promptly, that consideration be given to the problem of contamination of equipment to keep the pesticide out of mixtures which are not supposed to contain them, and that personnel should take all necessary precautions to protect themselves.

Some of these chemicals are distinctly poisonous. They present a hazard to workmen who might breathe vapors or particulate dusts, and many of the materials also present a distinct hazard by absorption through the skin. Some materials require that workmen wear protective clothing and masks or respirators. Workmen should wash frequently and avoid wearing contaminated clothing. Particular care may need to be taken to see that they do not eat or smoke on the job. Special venting and dust abatement might be needed.

Safety or accident prevention in its broad sense extends to consideration of economic as well as health hazards. With this in mind, emphasis must be given to the importance of weighing, blending, and packaging pesticide-fertilizer mixes with special care to make certain that each mixture satisfactorily conforms to both the fertilizer guarantee and the pesticide guarantee made for it. (It should be pointed out that official sampling in California shows that one fifth of all the mixed commercial fertilizers fail to conform to their declared plant food composition.)

Variations from guarantee are caused mainly by segregation of components, and different portions of the mixtures are found to be high in one component and low in another. These variations are already of much concern to the fertilizer industry but they might be intolerable in a pesticide, where a shortage might make the mixture wholly ineffective and an overage might make it injurious.

Pesticide - fertilizer mixtures continue to present a hazard during storage and distribution. If one lot of a commercial fertilizer were inadvertently used in place of a different lot, in general, the only concern would be in the matter of economics and depends only on the relative commercial value of the two. If, however, one pesticide were inadvertently used in place of another, or where none was wanted, or on

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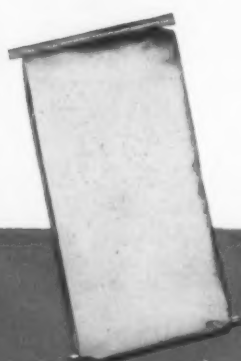
*Based on paper presented at National Safety Council and National Plant Food Institute Fertilizer Safety School, Fresno, Cal., Dec. 3, 1958.

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Appearance may be improved through better design, sharper color printing, reproportioning, or better choice of outside wall.

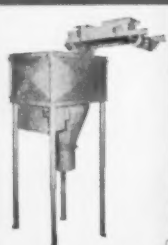
A frank discussion with us may result in a more attractive bag, reduced production costs and increased sales of your product.

When will you talk with our representative?



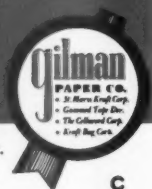
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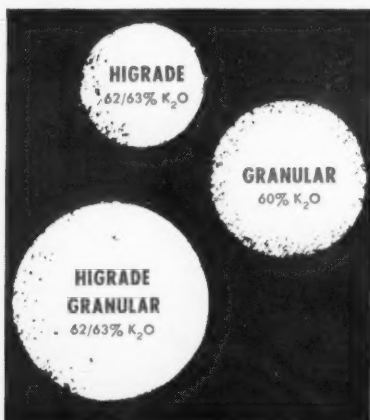
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THE LIQUID mixed fertilizer industry, now fairly well established in all parts of the country, is beset with several problems, some of which are peculiar to the industry. Steady progress is being made toward solving or minimizing these difficulties, with the result that the liquid route has become more and more promising as an efficient and economical means of applying fertilizer. The following is a review of the problems and a discussion of the status of the industry in respect to them.

The composition of a solid fertilizer mixture is important, but is not highly critical in regard to the handling characteristics of the mixture. The main requirement is to formulate in such a way that caking and other difficulties which would interfere with application are minimized. For liquid mixtures composition is much more critical, because improper formulation will cause salting out and make the mixture almost unus-

able in standard types of application equipment.

Because of this the liquid mixed fertilizer producer needs accurate data on solubility of the mixtures which he uses. It might be expected that such data would be available in the chemical literature; the compounds used are common ones and have been the subject of study by many workers. However, the particular combinations of salts used in the liquid mix industry have not been covered in general system studies reported in the literature.

The main difficulty is that the liquid mix combinations are much more complicated than systems of the type usually studied in solubility work. The fertilizer producer may have as many as six different compounds in his mix. This, plus water, gives a seven-component system, whereas systems reported in the literature seldom contain more than three components. Research workers seldom attempt a more complicated system

How to Minimize Salting-Out Problems in Manufacturing

Liquid Mixed

because of the great amount of time required for a complete solubility study.

Because of this situation, workers in the liquid mixed fertilizer field have made partial studies of their systems to give data needed for formulation. In one such study,

reported by Langguth et al. (1) R 1 the crystallization temperature of solutions having standard plant nutrient ratios was determined and the result expressed as the highest grade which would remain in solution at 32° F. This was a limited study in that no temperature range was included, intermediate nutrient ratios were not studied, the ratio of ammonia to phosphoric acid was fixed, and the source of supplemental nitrogen was restricted to either urea or ammonium nitrate. In a later study, Tucker, et al (4) R 4 investigated a range of temperature and also studied the effect of using urea and ammonium nitrate together in various proportions.

In work done recently at TVA (2) R 2 solubility studies were set up on a statistical basis in an effort to develop an empirical equation by which solubilities could be estimated over a wide range of composition and temperature. A simple equation containing only two terms was developed; one is the solubility at 32° F., and the other is a correction term for the effect of change in temperature. The value of the first term varies with the system involved and that of the second with the particular salt which crystallizes from the system. Experimental values for solubility at 32° F. were plotted on graphs in such a way as to allow interpolation for any plant nutrient ratio, and temperature coefficients for the various crystallizing salts were determined. Data on the identity of the salts crystallizing from various systems were also obtained to supplement those reported by Langguth et al. (1) R 1.

This work allows estimation of solubility over a wider range of composition and temperature than was possible previously. However, several limitations still remain; for example, only three ratios of ammonia to phosphoric acid and one ratio of urea to ammonium nitrate were studied. Much more work needs to be done if complete data is to be obtained on the complex solubility systems used in the liquid mixed fertilizer industry.

Grade of Solution

The average plant nutrient content of fertilizers in this country continues to increase from year to year. This problem is met in the solid fertilizer industry merely by omitting fillers formerly used or by removing unessential compounds from the fertilizer during manufacture. Such a course is not open to the producer of liquid mixes, because there is nothing he can leave out or remove to increase concentration. His only recourse is the use of the most soluble materials or combination of materials available.

One development in this respect is the finding by Tucker et al. (4) R 4 that a small amount of ammonium nitrate in conjunction with urea as a source of supplemental nitrogen gives an increase in solubility for several plant nutrient ratios. Special ammoniating solutions to take advantage of this effect have been offered. Producers have also used urea-ammonium nitrate solution along with ammonia-urea solution to obtain the optimum ratio of ammonium nitrate to urea.

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Fertilizers

which helps in getting higher solubility is adjusting the ammonia-phosphoric acid ratio to the optimum level. Most producers use a mole ratio of 1.7, whereas for grades low in potash a ratio of 1.6 or 1.5 usually gives higher solubility. Only a very few producers seem to be taking advantage of this.

The most promise in regard to raising the grade of liquid mixes is in use of new materials of higher solubility. One which has attracted some interest in the last year or so is superphosphoric acid, an acid made by the furnace process but with a much higher P_2O_5 content than the usual furnace phosphoric acid (76% versus 54%). In work reported by Striplin et al. (3) R 3 the super acid gave much higher concentrations when ammoniated than did ordinary phosphoric acid. The super acid is about half pyrophosphoric acid; when ammoniated this is much more soluble than ammonium orthophosphate.

The grade ordinarily made with super acid is 11-33-0. However, even higher grades can be made by increasing the P_2O_5 content of the super acid and thereby increasing the pyrophosphoric content. This has the disadvantage of departing from the optimum concentration of about 76%, at which point the acid is liquid and can be handled fairly easy; as the concentration is decreased or increased from this level the acid tends to set up at ordinary temperatures. A higher strength acid can be kept fluid after making, however, by keeping it hot. The hot acid can be ammoniated to give a grade as 12-40-0, stable at 32° F.

The advantage of using super acid is not as great when potash and supplemental nitrogen are added. Some increase in concentration is realized, but not nearly that for the ammoniated acid.

Superphosphoric acid is not yet available to the industry in other than experimental quantities. Several liquid mix plants have tried the material successfully and there is considerable interest in it throughout the industry. This growing interest may be a major factor in the development of a source of supply for the acid.

Other than superphosphoric acid, new materials for increasing solubility do not appear very promising. Potassium compounds such as potassium hydroxide, potassium phosphates, and potassium carbonate would be quite beneficial if they could be produced at a low enough cost to make them feasible. The limited solubility of potassium chloride and potassium nitrate is a handicap in many liquid fertilizer systems. However, with present production methods the cost appears to be too high for general fertilizer use.

Another development, not as far advanced as super acid, is achieving high concentration by suspending nutrient salts in their own saturated solutions. The method depends on keeping the crystals from settling to a hard cake and from growing to such a size that they would clog application equipment. In such a system salting-out temperature would no longer be a problem, since salts

coming out and going back into solution would merely change the amount of salt suspended.

Clays of the bentonite and montmorillonite type have been found helpful in stabilizing this type of suspension. Small amounts, 1 to 2% of the weight of the suspension, serve

to hold the salts in suspension and minimize growth of the crystals. The resulting suspensions settle very little and the crystals grow very little with time. However, viscosity is fairly high and the suspensions have a tendency to thixotropy.

This development is in the initial stages. Much work remains to be

done before the practicality of the method is established and before producers can use it with any assurance of success. One of the main questions is whether special and perhaps expensive equipment will be needed for applying the suspensions. There is much interest on the part of pro-

Turn to **LIQUID MIXES** page 19

By
A. V. Slack

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*From paper presented before the 9th annual Pacific Northwest Plant Food Assn., Gearhart, Oregon, Oct. 23-24, 1958.

CANADIAN Superphosphate Plant



Ontario Plant Producing at Near Capacity in Both Bulk and Bagged Goods; Company Now Plans to Put In New Phosphoric Acid Facility

MODERN production of superphosphate is being achieved at the Port Maitland, Ont., plant of Dominion Fertilizers, Ltd., located some 45 miles west of Buffalo, N.Y., near the shores of Lake Erie. Capable of shipping 150 tons of finished product an hour, the new plant, completed this fall, gets raw materials by truck, rail and barge. Processing is done under modern, dust-free conditions, with push-button controls permitting employment of a minimum number of men in the plant.

Erol Beker, president of Dominion Fertilizers, Ltd., explained the working of the plant to a group of visitors during a recent open house at Port Maitland. The facility cost in the neighborhood of \$2 million, he said, and its superphosphate production will go far toward supplying Canada's needs for this material. There will be adequate amounts remaining for U.S. markets, he added.

Mr. Beker said that the plant was erected in less than six months, with the foundation being laid about the middle of April and the first trial

run of the plant being made on Sept. 1, 1958. The plant is presently operating at near top capacity, it is reported.

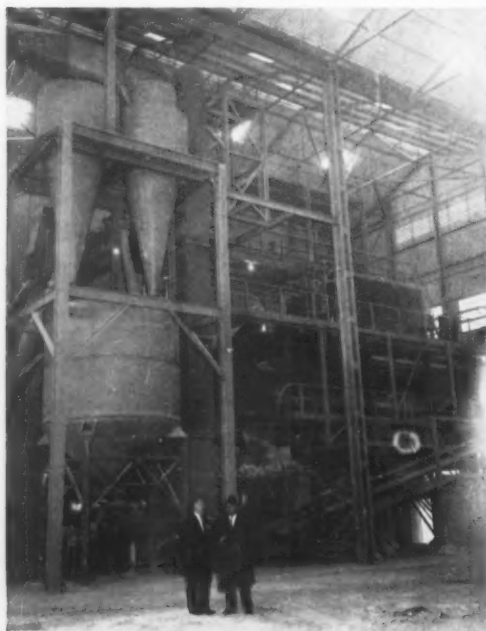
PRODUCTION FACILITIES—Dominion Fertilizers, Ltd., has well-equipped plant at Port Maitland, Ontario. Above, sulfuric acid tanks, each with a capacity of 1,500 tons. Acid is brought in by tank cars, stored in these tanks and piped into plant via underground ducts. Below: Dust collector cyclones in background help keep dust at a minimum in plant. Note light louvers in ceiling. Men shown were visitors at the recent open house. Center, rock phosphate storage in the plant. Rock is brought in by rail and by barge and enters plant by conveyor belts. At right: convenient under-cover truck dock makes it easy for customers to load up with either bulk or bagged superphosphate. The truck here is being bulk-loaded. The plant serves a wide agricultural area of Ontario and ships to other parts of Canada and the U.S.

Although raw materials come to the plant by means of highway and rail, cheap transportation is obtained through waterways. Located on a deep-water channel, the plant has an old ferry dock from which phosphate rock may be unloaded and transferred to the plant.

The new St. Lawrence seaway is expected to be a boon to the plant's operation, too, Mr. Beker said. Even though the waterway is icebound a good portion of the year, its proximity and convenience are a major factor in the operation.

Mr. Beker told the visitors that his company has unbounded confidence in the future of Canada's agriculture, pointing out how the population is increasing significantly year after year and the use of fertilizer is rising accordingly. In 1941, he said, Canada used 127,000 tons of commercial fertilizer, exclusive of manures and organic matter. At the present time, consumption of commercial fertilizer is nearly a half million tons a year.

The company plans to build a phosphoric acid



plant and the present building is constructed to allow expansion without major difficulty.

Two sulfuric acid tanks of 1,500 tons capacity each are located on the plant grounds, and ample space is available for additional tanks if production should demand it.

In addition, the plant has a drying and granulating unit with a capacity of about 30 tons a day. When the phosphoric acid plant is completed the firm will have an additional manufacturing capacity of around 100,000 tons triplesuperphosphate a year.

In addition to Mr. Beker, the plant is operated by W. R. Baugn, plant manager, and Jack Reid, office manager.

Sales of the plant's output are being handled by Philipp Bros. Chemicals, Inc., New York.

PESTICIDE PLANT

Continued from page 5

plant, Mr. Buckley says the rate will depend a great deal on the products being made and the way in which they are packaged. "In making insecticides, a simple-to-make product such as DDT packed in drums offers no problem to make 6,000 gal. a day on one shift. A similar amount of 2,4-D amine can be made simultaneously in the plant."

In making more toxic materials such as parathion, however, only about 2,300 gal. a day can be made because of the extreme caution exercised by the plant's management and clean-up and decontamination procedure involved. "On the average, we can put out about a car a day from each of the two pesticide plants," the manager states.

Housed in clean steel buildings, the plant has two completely separate formulating plants of equal size. Each plant, one for making insecticides and the other for herbicides, is a two-story structure 32 ft. by 100 ft. Each plant has its own warehouse for both raw materials and finished products.

The company has provided space in each plant to house two dust blending plants. These, however, will be moved into the new buildings shortly in order to have all manufacturing operations located in a central position.

"We feel that we have one of the finest plants of its type in the Upper Midwest and the unique feature is that the plant was conceived, designed, constructed and equipment installed by Agsco personnel," Mr. Buckley says. "The only outside contractors employed on the job were for installation of electrical wiring and putting in the boiler."

Products made in the herbicide plant include 2,4-D amine; MCP amine; butyl and isopropyl esters, low volatile esters and brush killers.

Liquid insecticidal products manufactured at the Agsco plant include formulations of DDT, aldrin, dieldrin, endrin, heptachlor, toxaphene, parathion and thiodan.

Although the capacity of the plant has not been estimated precisely, Mr. Buckley says that normal operations, using only one shift and a minimum crew can easily put out a carload of products from each of the two plants daily. The plants, he says, are designed primarily to manufacture products for the company's own distribution.

Farming areas of North Dakota, western Minnesota and northern South Dakota are served by the products of this plant. It has been making fertilizers since 1935 in the Grand Forks area and the firm now has a modern plant for making granulated products.

Over the years the company has operated its own control laboratory and on-the-farm research programs.

In addition to Mr. Buckley, manager, and Mr. Brown, president, other key people in the firm include C. W.

Sande, vice president and assistant manager; Olaf Haug, chemical plant superintendent and Dick Rayment, plant foreman.

Agsco also offers to farmers in the area a complete line of seeds for corn, legumes, grasses and grains, as well as steel storage buildings of the type used by the company for its chemical manufacturing and storage.

NAC Assn. Announces October Meeting Dates

WASHINGTON—The time and place of the 26th annual convention of the National Agricultural Chemicals Assn. have been announced by the NAC office here. The three-day meeting will begin Oct. 21 and continue through Oct. 23, the association says. Headquarters of the meeting will be the French Lick-Sheraton Hotel, French Lick, Ind. Details of the convention program, always of interest to pesticide formulators, will be announced later.



DECADE OF SERVICE CITED—Gordon Lilleflore, second from left, receives a 10-year pin for his services at the Smith-Douglass fertilizer plant at Albert Lea, Minn. M. W. Mawhinney, plant manager, second from right, is seen making the presentation. At the left is C. E. Myers, president of Jobs Building, Inc., Albert Lea, the organization which aided Smith-Douglass in establishing its Minnesota plant here in 1948. It was Jan. 9, 1949, that the first load of complete mixed fertilizer was shipped from the plant. At the right in the photo is William Sykes, secretary of the local Chamber of Commerce of which the Jobs Building organization is a part.

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WESTERN STATES

INSECTS: wireworms, root maggots, strawberry root weevils, flea beetles, clover root weevils

CROPS: vegetables, corn, potatoes, berries, other crops

TIMING: March & April

CORN BELT STATES

INSECTS: corn rootworms, wireworms, cutworms, white grubs, seed corn maggots, Japanese beetle larvae, root weevils

CROPS: corn, potatoes, vegetables, other crops

TIMING: March, April, May

KENTUCKY

INSECTS: wireworms, mole crickets, seed corn maggots, tobacco webworms, green June beetles, cutworms

CROP: tobacco

TIMING: April & May

EASTERN STATES

INSECTS: wireworms, white grubs, European Chafers, rootworms, Colorado potato beetles, flea beetles

CROP: potatoes

TIMING: January through April

SOUTH CENTRAL STATES

INSECTS: Rough headed corn stalk beetle

CROP: corn

TIMING: March & April

GEORGIA-ALABAMA

INSECTS: wireworms, southern corn rootworms, white fringed beetle larvae, Colorado potato beetles

CROP: potatoes

TIMING: January and February

INSECTS: white grubs

CROP: peanuts

TIMING: March and April

THE CAROLINAS

INSECTS: thrips, southern corn rootworms

CROP: peanuts

TIMING: April, May

INSECTS: wireworms, cutworms, flea beetle larvae

CROP: tobacco

TIMING: March

INSECTS: wireworms, southern corn rootworms, white grubs

CROP: corn

TIMING: February

FLORIDA

INSECTS: wireworms, cutworms, white grubs, white fringed beetles, mole crickets, rootworms, flea beetles, ants

CROPS: sweet corn, tomatoes, potatoes, melons, vegetables, other crops

TIMING: September through December

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PHYSICAL ASPECTS OF . . .

Accident Proneness

By John H. Foulger, M.D.

E. I. du Pont de Nemours & Co., Inc.
Wilmington, Del.

THE SEEMING liability of certain persons to multiple accidents has been the subject of many studies over the years. The term "accident prone" as applied to individuals has become almost a stigma in some instances. More light needs to be shed on this phenomenon. The following discussion should help to clear up terminology and aid in evaluating circumstances in fertilizer and pesticide plants where accidents may occur.

One of the numerous studies was one made by the Industrial Health Research Board some years ago, the report of which stated: "The fact that one of the factors connected with 'accident liability' has been found to be a peculiarity of the individual allows us to differentiate between 'accident proneness' and 'accident liability'."

"'Accident proneness' is a narrower term than 'accident liability' and means a personal idiosyncrasy predisposing the individual who possesses it in marked degree to a relatively high accident rate. 'Accident liability' includes all the factors determining accident rate."

As the years went by, "accident proneness" became a favorite study, particularly of industrial psychologists and psychiatrists. But, apparently, it was forgotten that the original calculations of Greenwood and Wood were based on accident records collected over a relatively short period of time. There was no indication in their report or in subsequent papers by others that a worker who, during that period of investigation, incurred multiple accidents, would necessarily continue this pattern as the years went by.

The term "accident prone" has tended to be used as an explanation rather than as a mere description of the accident record of particular individuals. Actually it has become a stigma. Rawson has

gone so far as to state that "accident prone individuals are accident prone in any occupation." Without proper investigation, workers so labeled may be deprived of employment. This situation has developed in spite of warnings by such an authority as Vernon that "the accident proneness of various individuals is not fixed but is liable to be affected by any and every change in their bodily condition. This condition is influenced by external changes in environment as well as by internal changes in the physical and mental health."

My personal interest in the problem was aroused some years ago during a visit to Canada. The production manager of the high explosives division of a large corporation posed this question: "Can you explain this? Tom Jones, one of our oldest employees and our most experienced glycerine nitrator, came to the plant on Monday morning. In setting up a nitration apparatus, he turned the wrong valve. There was a violent explosion. Luckily, Tom survived. After he had overcome the shock, he told us exactly what he did wrong, but he could not tell us why he did it."

Explanations given for accidents such as youth, lack of training, failure of safety instructions, lack of skill, lack of experience obviously do not fit this situation. Tom Jones was in his late forties. He was a highly skilled and experienced nitrator of glycerin. Safety training and safety precaution long ago reached a high level of efficiency on dynamite plants.

At the time this question was posed, we were studying the influence of work in various chemical operations upon blood pressures and pulse rates. These were chosen because they are good indices of the effects of physiological stresses to which any individual is exposed. They are easily and frequently measured by standard procedures which do not

"An accident occurs when a vulnerable individual meets a hazardous situation. The elimination of the hazardous situation is the business of the safety engineer, but the vulnerability of the individual is the concern of the industrial physician."—Dr. Foulger.

divert a worker too long from his job and do not cause him embarrassment. They can be expressed numerically and are, therefore, amenable to mathematical analysis.

Over the years, between 1936 and 1942, several formulae were developed for studying blood pressure trends. By using them, we were able to classify various operations in our plants in order of the degree of health hazard, to follow the effect of improved ventilation or improved personal protection of workers and even to disclose unsuspected sources of hazards.

We have accumulated voluminous data on blood pressure changes in some workers in all types of occupations in our chemical plants. Since the measurements have been made on different days of the week and at different times of the day, it has been possible to detect any rhythms that may occur during the work day or week, or even during the various seasons of the year.

It soon became quite obvious in these studies that many workers approach their work on the first day of the work week under conditions of stress which produce abnormal blood pressures and pulse rates. They may or may not improve during the first work day or the whole work week.

Others approach the first hour of work in very good physiological condition. If the industrial environment is poor, if there is exposure to abnormal extremes of temperature and humidity, or to hazardous chemicals, or to heavy physical labor, the condition of some workers may deteriorate during each work day and as the work week advances.

A worker under such a condition of stress that his blood pressure at the beginning of the work week is either abnormal or on the borderline of being abnormal will show further deterioration in his condition if work situations are adverse.

Among the mathematical tests used was a scoring system based upon the probability of simultaneous occurrence of various levels of two important factors in blood pressure, namely, the diastolic pressure and the pulse pressure.

Our scoring system is based upon records, some 30,000 in number, collected over several years.

After my conversation with the production manager in Canada, I very carefully reviewed some of our records on blood pressure, collecting them by hours of the day. It became obvious that the ratio of the group's number of abnormal scores to those expected by chance increased from the beginning of the work day, up to about eleven o'clock in the morning, and then diminished slightly during lunch time. It increased again in the afternoon and moved upward until about one hour before the end of the work day.

Now this particular trend has been recorded over the years both here and abroad as the trend of the number of accidents during the work day. Many attempts have been made to explain it but they have all centered upon measurements of production or of the work load. Very few if any have been concerned with the physical condition of the workers.

In all situations in which we have had an opportunity to compare the trend of the index of abnormal blood pressure scores with the trend of the number of all accidents, including minor accidents, we have found a very high degree of correlation between these two factors. Of course, it has not been possible to directly correlate blood pressure status and the occurrence of accidents for an individual worker.

Obviously, since an accident is an unexpected event, one is not standing ready to measure the blood pressure before it occurs. Obviously, also, since the action itself places a severe stress upon the worker, one can get no useful information by measuring blood pressure immediately after the accident has occurred. But when one of the factors studied is a measure of the effects of physiological stress upon a human being and the other is a measure of his behavior under stress, then a search for the basis of the physiological data may give some explanation of the behavior.

Our blood pressure score becomes abnormal when either the pulse pressure or the diastolic pressure rises or falls beyond certain limits. A rise in pulse pressure is caused by annoyance, by severe pain, by anger, by a general feeling of frustration. A fall in pulse pressure may be produced by incipient illness, by excessive fatigue, by emotional depression.

A rise in diastolic pressure rarely occurs under usual conditions. But a fall in diastolic pressure, which will give an abnormal score, can be produced by severe fatigue or shock (including emotional shock) by acute exposure to hazardous chemicals, by prolonged loss of sleep, or by worry over family matters. All of these factors have been found to exist in careful studies of workers in our plants who have shown abnormal blood pressure scores.

In the early days of our application of the scoring system, one plant manager complained that the method was too sensitive. It would even indicate when a new foreman took charge of a group of workers. If the foreman were new to the group, if there should be resentment in the group because one of them had expected to be promoted to this position, if the foreman was too much of a "new broom" and put increased pressure upon the group the pulse pressures of those men would rise.

Other aspects of the same problem have been studied recently by Funkenstein and his colleagues. They conducted a test in which they deliberately tried to force a group of stu-

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Arcadian® News

Volume 4

For Manufacturers of Mixed Fertilizers

Number 1

Technical Tips for Better Ammoniation

ADVANTAGES OF SULFURIC ACID IN MAKING MIXED FERTILIZERS

FUNCTIONS of SULFURIC ACID

SULFURIC ACID has three important functions in the manufacture of mixed fertilizers:

1. Reacts "excess" ammonia when the formula contains more ammonia than can be reacted with superphosphate.
2. Increases the heat of the mass for better granulation.
3. Adds sulfur to the mixed fertilizer. Most leading crops are big users of sulfur. (See article on next page.)

Today's higher-analysis mixed fertilizers require correspondingly higher proportions of nitrogen solutions in formulation. As a result, the superphosphate often cannot react all of the ammonia contained in nitrogen solutions, and the producer has an "excess" ammonia problem to solve.

Sulfuric acid is the answer. This potent chemical reacts very efficiently with the "excess" ammonia, delivering the maximum ammoniation necessary to produce high nitrogen content. Consult the following table to see how much sulfuric acid to use for each pound of "excess" ammonia in the formula.

SULFURIC ACID

Grade	Per Cent Acid	Per Cent Water	Pounds Reacting With 1 lb. Ammonia
60° BE	77.67	22.33	3.58
66° BE	93.19	6.81	3.09
	100.00	0	2.88*

*(For comparison—not used.)

Even before "excess" ammonia became a common problem, many fertilizer producers were using sulfuric acid for its great aid to granulation. Properly used,

sulfuric acid raises the heat of the mass, yielding a more desirable liquid phase or plasticity. This, in turn, permits better granulation at lower initial water content. The following table points up the spectacular heat generation properties of sulfuric acid as compared with other materials.

Heat Generated by Reacting Ammonia

Material	B.T.U.'s of Heat Per Pound of Ammonia, Approximately
Superphosphate 20% P ₂ O ₅	1460
Triple Superphosphate	1540
Phosphoric Acid	1900
Sulfuric Acid	2940

The specific heat of fertilizer (B.T.U.'s required to raise one pound 1° F) is generally placed at about .25. This means that 500 B.T.U.'s are required to raise (or lower) a ton of fertilizer 1° F. Now the evaporation of one pound of water in the formulation process absorbs about 1040 B.T.U.'s, which would cool a ton of fertilizer about 2° F.

Above 180° F, the evaporation of water is quite rapid. Of course, the con-

densing of one pound of steam dissipates the aforementioned 1040 B.T.U.'s and would theoretically raise the temperature of the fertilizer about 2° F. However, the heat losses from radiation are considerable at the higher operating temperatures, particularly as little, if any, effort is directed toward conserving heat. It is difficult to compute heat losses from radiation without specific data on the equipment used.

The combined loss of heat from the evaporation of water, radiation and heating the surrounding air is so great that mass temperatures above 220° F are attained only at very high heat input. In most fertilizer operations, equilibrium seems to be reached at 230° F or 240° F. If the temperature in the ammoniating equipment exceeds these levels the operation is suspect. There is probably too little water present for reasonable safety, or some other control has failed, making it possible for unwelcome reactions such as fires, fumes or explosions to occur.

How to Use Sulfuric Acid

It is normal good practice to introduce and mix the nitrogen solution as uniformly as possible with the superphosphate. This assures maximum ammoniation and produces good physical condition without fumes or loss of ammonia. Careful, uniform mixing is also necessary when adding sulfuric acid to the mass. And it is most important that sulfuric acid be added *before* the ammonia.

In its simplest form, the introduction of sulfuric acid should be through a spray pipe (acid distributor) drilled somewhat like the ammoniating pipe. In the batch rotary mixer this calls for a rather slow

distribution of acid; but not as slowly as when distributing ammonia at higher quantities in superphosphates, for entry of the acid into the dry ingredients is essentially a *physical* act. Entry of ammonia on the other hand, is a *chemical* action—with ammonia take-up in the superphosphate getting slower and slower as saturation is approached. Sulfuric acid reacts very fast with ammonia at all stages of the mixing process.

In continuous ammoniation operation, the acid should be added continuously through numerous small holes or slots in distribution pipes running virtually the full length of the mixer. Many producers add the acid below the surface of the mass near the ammoniating distribution pipe.

The important thing is to avoid any heavy concentration of acid in the mass. And, of course, sulfuric acid and nitrogen solution should *never* be distributed through the same pipe, as serious accidents can occur.

Sulfuric Acid and Safety

There has been much concern (and rightly so) over safety in the use of sulfuric acid and ammoniating solutions. The handling and proportioning of the acid itself, as well as its distribution in the fertilizer mass demands careful procedures. It is extremely destructive to human tissues. Every precaution must be taken to prevent contact with any part of the body. Adequate safety equipment in the plant, and protective clothing, gloves, face masks, and goggles are absolutely necessary.

A potential hazard is the presence of potassium chloride in the fertilizer mass. Sulfuric acid reacts with this potassium chloride during the complex actions in the mass to form hydrochloric acid, a strong oxidizing agent. Some operators have greatly reduced this reaction by delaying the introduction of the potassium chloride until after the sulfuric acid has been neutralized by the ammonia.

Of course, sulfuric acid and nitrogen solution should never be added to each other when there are *no* dry ingredients in the mixer. This could result in a bad flash fire, or even a mild explosion. Actually, this same condition sometimes occurs in continuous mixers where the mass does not rotate or tumble as intended, but merely "rocks" as one lump. Here, too, flash fires are a hazard. For, in effect, the acid and nitrogen solution are being mixed together, with virtually no intervening regulating or restraining action.

Safe Equipment

Accidents can stem from poor distribution of nitrogen solution or acid because of worn or corroded distributor pipes. Then too, some distributor pipes are of such questionable design as to give dangerous delivery even when new.

Centrifugal pumps with emergency shut-down switches (preferably several), placed in quickly accessible, safe locations, are recommended rather than air pressure for moving sulfuric acid. Should a pipe or valve fail with acid under air pressure, a great amount of acid could be sprayed around before the flow is stopped.

For batch operations a simple, elevated measuring tank using gravity flow to the mixer is advised. Gauge glasses should be avoided. This can be done by having the liquid level relayed through a stainless steel cable and pulleys to a vertical board and marker. The measuring tank should be large enough to accommodate as many as 10 or 12 batches to minimize the number of times required for filling. An overflow pipe returning from the measuring tank to the storage tank must have a capacity greatly exceeding that of the pump to avoid overflow. This overflow pipe should be connected well below the top of the measuring tank. A visual and aural alarm should be part of the tank equipment, to warn the operator when the acid level has exceeded the safe point.

Provisions should be made against permitting sulfuric acid to be confined in ordinary steel between two tightly-closed valves, or any arrangement that permits excess pressures. Hydrogen is released by the action of sulfuric acid on steel and excessive pressures can develop. Also, hydrogen itself is a distinct fire and explosion hazard, hence the restraint against smoking, fires, etc.

Sulfuric Acid Pays Off

It is well worth the effort to learn how to use sulfuric acid correctly and safely in formulations. More and more producers are using it successfully in increasingly greater amounts per ton of fertilizer. You, too, will be rewarded by turning out the fine quality, high-analysis fertilizers in demand today. Check your sulfuric acid supplier. Most suppliers furnish, on request, detailed literature on the properties, use and safe handling of their product. And, of course, our technical service staff is always ready to help with specific formulation problems. Write Technical Service, Nitrogen Division, Allied Chemical, 40 Rector Street, New York 6, N. Y.

BENEFITS of SULFUR in Crop Production

Sulfur is more deficient in soils than phosphorus, according to a recent general soil survey. In many important growing areas across the country, crop response to sulfur has been noted.

The Eastern Seaboard states, particularly Florida, Georgia and Alabama, have considerable soil that is deficient in sulfur. The same is true of Minnesota and Nebraska, with some neighboring Midwestern states also indicating the development of sulfur deficiencies. Research in most states west of the Rockies reveals crop response to sulfur.

To date, however, sulfur requirements of plants have been ignored to a large extent because most fertilizers have carried substantial amounts of sulfur along with nitrogen, phosphorus and potash.

Unfortunately, fertilizers which are sulfur-free now are increasing in use, although the value of sulfur in mixed fertilizers is abundantly clear. Land that is fertilized with nitrogen, phosphorus and potash, but not sulfur, will undoubtedly show sulfur deficiencies.

There is a great need for high-analysis, high-nitrogen mixed fertilizers to provide crops with vital growing power. With continued cultivation, nitrogen deficient

cies have developed, and response to nitrogen fertilization can be demonstrated in almost any area of the country. In manufacturing high-analysis mixed fertilizers for farmers, fertilizer manufacturers should make certain that the mixed goods contain adequate sulfur.

Organic matter is the chief natural source of both nitrogen and sulfur in the soil. With no nitrogen fertilization, the sulfur released by decomposition of organic matter would be adequate for crop needs. However, adequate nitrogen fertilization is necessary, and there is not enough decomposition of organic matter in the soil to provide sulfur for crop needs. It has been noted that sulfur response in non-legume crops can be expected to occur most commonly at high levels of nitrogen fertilization.

Sulfur Leaches Fast

Although sulfur is available to plants as sulfate, studies show sulfate can be easily leached out of many soils. Surface soils in the Southeast, for example, are badly leached. This is particularly true of the light soils of the Coastal Plain. Shallow-rooted crops and seedling plants

grown there are often deficient in sulfur. Bacteria in the soil use sulfur in much the same manner that they use nitrogen. If a crop residue that is low in nitrogen but high in energy, such as corn stalks, is plowed under, the bacteria use the available nitrogen before the next crop can get it, and a nitrogen deficiency develops. The same effect has been noted in sulfur experiments.

All of this builds up an impressive case for adding an adequate amount of sulfur to high-analysis mixed fertilizers. The following table shows the sulfur contained in commonly-used fertilizers made from ammoniated superphosphate.

Per Cent of Sulfur in Various Fertilizers Made from Ammoniated Superphosphate

Fertilizer	Sulfur
16-8-8	8.5%
15-10-10	7.6%
8-8-8	6.2%
12-12-12	7.0%
6-12-12	7.3%
4-16-16	6.9%
5-20-20	4.0%
6-24-24	less than 1%
13-39-0	less than 1%

Sulfur is classed as a secondary element. This implies that plants use less sulfur than nitrogen, phosphorus or potash. However, this is not necessarily true. On an elemental basis, the corn plant actually uses as much sulfur as it does phosphorus.

Elemental Composition of Corn (Grown at Manhattan, Kansas)

	Leaves	Stem	Grain	Root	Cob
Nitrogen	1.30%	0.84%	2.15%	1.27%	1.38%
Phosphorus	0.21%	0.09%	0.34%	0.12%	0.94%
Potassium	1.48%	1.23%	0.42%	0.48%	0.46%
Sulfur	0.24%	0.16%	0.14%	0.25%	0.02%

A 100-bushel corn crop requires about 160 pounds of nitrogen, 25 pounds of elemental phosphorus, 100 pounds of potassium and 25 pounds of sulfur.

The role of sulfur in growing good corn provides a prime example of why it is important to use an adequate amount of this important ingredient in manufacturing mixed fertilizers.

Corn is the biggest single market for fertilizer in this country. To grow big yields of corn, it is necessary to use a lot of nitrogen. Therefore, a high-analysis, high-nitrogen mixed fertilizer, such as 2-1-1-S, is ideal for corn. It is obvious that a high-nitrogen combination is needed, and that adequate sulfur must also be included in high-analysis fertilizer.

ARCADIAN® Nitrogen Solutions make it easy to formulate the right kind of high-analysis mixed fertilizer in almost any plant. In making these fertilizers, remember that ammoniated superphosphate is a rich source of sulfur. When you ammoniate normal superphosphate as a base for mixed fertilizers, you are giving farmers a big extra value in free sulfur and calcium essential to profitable crop production on many soils.

TONNAGE OPPORTUNITY:

BULK FERTILIZER BULKS UP SALES

It will pay you to take a long look at bulk fertilizers. This method of handling automatically favors heavier application per acre and greater total sales. And the larger farmers who are the best fertilizer customers often prefer the bulk system for a large part of their tonnage. Where bulk service is good, many farmers use it even where the products offered in bulk are inferior to those offered in bags.

Save Time and Labor

Handling fertilizers in bulk provides definite savings in time and labor for farmer, dealer and manufacturer. Where bulk fertilizers are handled mechanically, farmers are less apt to scrimp on recommended application rates per acre.

Many bulk truck and trailer units now on the market do an excellent job of spreading fertilizer for plow-down or top-dressing. Self-unloading feed and grain wagons are being designed for the additional job of handling fertilizer. Portable bins, hauled on trucks or wagons, are being used for fertilizer as well as for crops. New fertilizer broadcasting equipment is being designed with larger hoppers, and many farmers and dealers are also improvising bulk fertilizer equipment. New planters and drills come equipped with bigger hoppers located for convenient filling from bulk as well as from bags. Hauling equipment is also being adapted for easy mechanical unloading into fertilizer hoppers on planters.

Strengthen Distribution

The large investment needed for specialized bulk equipment helps to discourage the part-time dealer and the in-and-out price opportunist. Dealers who have invested in fertilizer-handling equipment must concentrate on doing a better job of merchandising to protect this investment. They are more inclined to stay active every year, to develop stronger and more stable markets. The natural result is a stronger distribution system built around better service.

The need for custom application of much of the bulk fertilizer tonnage is no real handicap to bigger sales. Efficient, large-scale custom equipment enables good operators to apply fertilizer at low cost per ton. The farmer is often happy

to be relieved of the job. Many a custom operator finds that his close contact with the farmer helps him do a better all-around job of sales and service.

Equipment Builds Sales

Fertilizer manufacturers can benefit greatly by working with equipment suppliers on improving bulk handling systems. Fertilizer dealers can help by working closely with farm equipment retailers to stimulate the sale of suitable equipment to farmers. It also pays to encourage custom applicators and dealers to get efficient new large-scale machinery.

Dealer ownership of bulk storage and handling equipment helps to reduce the fertilizer manufacturer's perennial problem of off-season storage and peak-season service. Some manufacturers have profitably increased their sales by supplying or subsidizing bulk storage and handling systems for dealers.

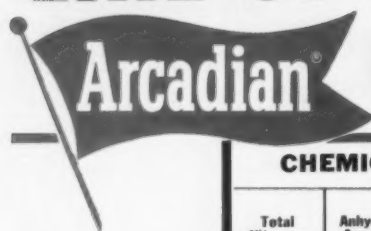
It will pay you to look into bulk handling of fertilizers as a method of increasing business and profits, and as a means of building a more stable distribution system with valuable long-term benefits. Before the spring rush hits, be ready for bulk business.

Nitrogen Helps Grass Exceed Alfalfa in TDN and Protein

Brome and orchard grasses, heavily fertilized with nitrogen, produced more total digestible nutrients and more digestible protein than alfalfa, in tests at the New Jersey Dairy Research Farm. These continuing studies accurately determine yield of feed per acre and digestibility of roughage fed to dairy cows.

Orchard and brome grass, fertilized with 200 pounds of nitrogen per acre, produced 1,947 pounds and 2,118 pounds of TDN per acre, respectively. Alfalfa fertilized with 600 pounds of 0-10-20 per acre produced 1,242 pounds of total digestible nutrients per acre. The fertilized grass produced about 50% more digestible protein per acre than the alfalfa. Fat and fiber in the fertilized grass was also much more digestible than in the alfalfa.

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NITROGEN SOLUTIONS

	CHEMICAL COMPOSITION %					PHYSICAL PROPERTIES			
	Total Nitrogen	Anhydrous Ammonia	Ammonium Nitrate	Urea	Water	Neutralizing Ammonia Per Unit of Total N (lbs.)	Approx. Sp. Grav. at 60°F	Approx. Vap. Press. at 104°F per Sq. In. Gauge	Approx. Temp. at Which Salt Begins to Crystallize °F
NITRANA®									
2	41.0	22.2	65.0	—	12.8	10.8	1.137	10	21
2M	44.0	23.8	69.8	—	6.4	10.8	1.147	18	15
3	41.0	26.3	55.5	—	18.2	12.8	1.079	17	-25
3M	44.0	28.0	60.0	—	12.0	12.7	1.083	25	-36
3MC	47.0	29.7	64.5	—	5.8	12.6	1.089	34	-30
4	37.0	16.6	66.8	—	16.6	8.9	1.184	1	56
4M	41.0	19.0	72.5	—	8.5	9.2	1.194	7	61
6	49.0	34.0	60.0	—	6.0	13.9	1.050	48	-52
7	45.0	25.3	69.2	—	5.5	11.2	1.134	22	1
URANA®									
6	42.0	19.5	66.3	6.0	8.2	9.3	1.178	10	34
6M	44.0	22.0	66.0	6.0	6.0	10.0	1.158	17	14
10	44.4	24.5	56.0	10.0	9.5	11.0	1.114	22	-15
11	41.0	19.0	58.0	11.0	12.0	9.2	1.162	10	7
12	44.4	26.0	50.0	12.0	12.0	11.7	1.087	25	-7
13	49.0	33.0	45.1	13.0	8.9	13.5	1.033	51	-17
15	44.0	28.0	40.0	15.0	17.0	12.7	1.052	29	1
U-A-S®									
A	45.4	36.8	—	32.5	30.7	16.2	0.932	57	16
B	45.3	30.6	—	43.1	26.3	13.5	0.978	48	46
Anhydrous Ammonia	82.2	99.9	—	—	—	24.3	0.618	211	-108

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PRODUCTION

Man of the Month

Idaho Superintendent Utilizes Many Years of Experience in Plants

SUPERINTENDENT of a basic manufacturing plant producing superphosphate, triple superphosphate and phosphoric acid, is O. C. Finkelnburg, of J. R. Simplot Company, Pocatello, Idaho. The plant employs from 120 to 165 men, depending upon the season.

Now some 38 years old, the Simplot superintendent has had many years of preparation and experience in the plant food business. He entered the University of Idaho in 1939, just in time to be caught in the war at the end of four years. In 1943 he joined the U.S. Army Air Corps and was discharged in 1945 as a 1st lieutenant. He was with the 15th air force in Italy, won the air medal, 3 oak leaf clusters, D.F.C.

Going back to the university, Mr. Finkelnburg earned his B.S. degree in metallurgical engineering in 1946 and his master's in the same subject the following year. His thesis was on "Beneficiation of Idaho Phosphate Rock," published as a bulletin of the university.

Since he has been with Simplot, the plant capacity has been increased



O. C. Finkelnburg

by over 50% and the new pelleted-type triple superphosphate fertilizer has been developed.

The plant serves a large area of the western portion of the U.S. with its plant food products.

Mr. Finkelnburg is father of two boys and a girl, and loves to go hunting, fishing and bowling for recreation.

LIQUID MIXES

Continued from page 11

ducers and raw material suppliers, and research on the method is being carried out by various groups.

Cost of Raw Materials

The production of liquid mixed fertilizer has an advantage over solid mix production in the cost of plant and the cost of operating it. Raw material cost, however, is a different matter and is one of the major problems in the liquid mix industry.

There is no particular problem in regard to cost of potash and supplemental nitrogen since about the same materials are used for both liquid and solid mixes. There is even some advantage to liquids by use of solution forms of nitrogen rather than the solid form; many producers now use liquid only. In solids production, some solid nitrogen normally is used in many grades.

The main problem is in regard to phosphate, for which furnace phosphoric acid is the usual raw material. The lower cost of wet-process acid in most areas has led to a major effort in finding ways to use it. The various efforts to avoid the problem brought about by the impurities in wet-process acid can be grouped under the following headings.

1. Purifying of Acid: The problem can be minimized by giving some attention to the purity of the acid at the producing point. Some producers

now do this, either by extended settling or by chemical additions to precipitate some impurities. However, the major impurities—iron and aluminum—are not removed by these procedures.

2. Precipitation of Impurities: The iron and aluminum precipitate upon ammoniation of the acid and can then be removed by filtering, decantation, or other separation methods. The precipitate, however, contains part of the phosphate and must be recovered and used. For a producer making only liquid mixed fertilizer this is a difficult problem. For this reason the method is more applicable to plants that also produce a solid NP or NPK fertilizer, into which the settled sludge or filter cake from the acid ammoniation step can be incorporated.

3. Sequestration of Impurities: Since the producer of liquid mixes normally has no good way to handle separated impurities, he must leave them in and try to find some way to get an acceptable product. One approach is to add a sequestering agent that will prevent the impurities from precipitating when the acid is ammoniated. There are several agents which will do this but most of them are too expensive. The only one that appears promising is superphosphoric acid; the pyrophosphoric and polyphosphoric acid it contains will se-

quester impurities as well as supply phosphate to the solution.

Work on this method is being carried out by TVA and by several producers. For some types of wet-process acid as little as 10% replacement of wet-process acid with super acid gives a fairly clear solution after ammoniation. However, wet-process acid varies in composition and some types have required much more super acid. Moreover, addition of supplemental nitrogen and potash makes it necessary to use more sequestrant.

This method of using wet-process acid has aroused much interest throughout the industry. Work is continuing on determination of the amount of sequestrant needed under various conditions and the best ways of using it. In this method, as well as the use of super acid to increase liquid fertilizer grade, availability of the acid is a problem.

4. Suspension of Impurities: A simple and attractive approach is to allow the impurities to precipitate and suspend them in such a way as to give satisfactory handling and application properties. Considerable work has been done on this method also, by TVA and by various producers and raw material suppliers. Conditions during the ammoniation step have been found to have an important effect on the properties of the suspension, and a suspending agent such as a clay has been found helpful.

Variability of the acid is a problem in this method also. The tendency of the suspension to gel is another. Much more work is needed on these problems and on the several others involved in getting an acceptable suspension.

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Training Program Teaches Efficiency and Safety to Chemical Plant Employees

By J. C. Jessen

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Wilmington, Del.

Part II

PART ONE of this article discussed some of the factors involved in plant maintenance, including the first seven of eighteen basic rules adaptable to different plant organizations, accounting procedures, tabulating equipment, and other considerations.

The seven rules presented in Part I were: 1. Set up a proper maintenance organization. 2. Establish a work order system. 3. Keep equipment records. 4. Analyze and plan jobs. 5. Make weekly forecasts. 6. Prepare daily work schedules. 7. Set up manpower backlog control.

In this, the concluding portion of the article, we begin with the rule of establishing a preventive maintenance program and end with the rule for analyzing performance and costs.

Establish a Preventive Maintenance Program

Preventive maintenance consists primarily of doing maintenance when YOU want to, rather than when the EQUIPMENT wants to. Equipment left to its own devices seems to have a fiendish ability to do one of the following:

- Fail after the regular day shift, thus requiring overtime.
- All fail together without warning.
- Break-down so that maintenance work is required on Christmas or New Year's Day.

Through the preventive program we are able to perform most of our maintenance work during the daylight hours on the first shift and schedule it so that the available manpower is continuously busy rather

than working in surges. This greatly decreases overtime costs.

Another great advantage of preventive maintenance is that a whole equipment train can be maintained at one time rather than shutting down four or five times to maintain various equipment items in the train at different times. This greatly reduces product loss.

An outstanding example of the amount of maintenance work that can be set up on regularly scheduled preventive basis is one of our plants which has set up 60% of its maintenance work in this manner.

Use Budgetary Control

Knowing how actual maintenance costs compare with budgeted costs in a typical plant is valuable information.

It would be difficult to establish a workable maintenance budget without the advantages of the eight preceding tools. They pinpoint 50-60% of our requirements. We prepare a maintenance budget on an annual basis, broken down into monthly subdivisions. The monthly budget varies according to seasonal requirements and vacations. It is not a fixed budget but a guide to staying within the annual budget, which IS fixed. The budget may be set up by plant area or product if the maintenance responsibility is so established.

Provide Material Control

The establishment of spare parts for each piece of equipment prevents serious delays. Catalogs, drawings correspondence and past experience are used to establish maximum and minimum amounts for all spare parts and extra machinery. Stores items are also accurately determined.

We make sure the system is followed in every detail. This is important to build up confidence by the

maintenance organization that materials will always be available. Otherwise the maintenance men will establish caches of critical items in remote plant areas—and this practice can prove costly. Sometimes such materials are exposed to corrosive gases and liquids. Also, the exact contents of the cache are seldom known, and much time is lost hunting a desired item.

One should adopt the type of parts distribution system needed—whether all centralized or with subdepots—depending on factors such as plant size and type. But, whatever system is established, it must be used.

Plan Your Plant Shutdowns

This is important for large-scale, continuous-operation plants where any lost production is costly. A determination of optimum shutdown frequency is made first, by determining the expected life of various critical components in each equipment group. Next, for each group we establish the shutdown frequency that permits the over-all minimum downtime. Then we fit in the planned shutdowns for other equipment groups. Such a program permits us to hold our maintenance organization to its smallest possible size and to operate with a minimum of maintenance overtime.

Set Up Major Overhaul Procedures

We believe there is usually "one best way" to disassemble, check, replace parts, or reassemble any piece of equipment. We determine the best method through collaboration by our engineers, foremen, and maintenance men. After such study we write down the required crew size, and establish overhaul steps in proper sequence. Also, we list required tools and probable parts requiring replacement. We question every move, always looking for a better method or tool.

Our plants have discovered many ingenious methods to reduce overhaul time up to 50%. A typical example is that of having workmen enter an

oven that's being slowly cooled, wearing air-cooled asbestos suits—thus saving precious hours.

Improve Your Equipment

Many installations lend themselves to improvements in safety, output and ease of maintenance. One example might be an autoclave which in its original form had piping, valves and insulation arranged in such a manner that the insulation had to be removed for maintenance of the unit. A rearrangement of the pipes and valves so they were enclosed within an insulated box, which was easily removable, resulted in significant savings.

This is what we mean by corrective maintenance. The long-range program is the simplification of the maintenance problem by making parts more accessible, or of better material and design to require less frequent replacement.

Design standardization is given consideration wherever practical. For example, an extensive survey of heat exchangers resulted in standardization that permits not only interchange of tube bundles, but also the corroded tube ends to be cut off for reuse in shorter exchangers.

This program must be planned, and competent engineers must be assigned to make improvements and follow the performance of test modifications.

Train Your Supervisors

After accomplishing the first 15 steps it might be easy to conclude that adequate maintenance requires only perfunctory supervision. Such is not the case. We have learned that all levels of maintenance supervision must be trained to understand and use the maintenance controls. An important part of the training is to emphasize that the maintenance controls have the strong support of management.

Specifically, we have found it necessary to train foremen how to prepare work orders, equipment record cards, job analysis sheets, and so on. Our problem is to impress lower levels of supervision that preplanning and scheduling must precede the actual work if we are to provide good job effectiveness.

Again we must emphasize that the day of the "Bull of the Woods" foreman is over. The du Pont Co. now has one engineer for every fifteen employees. Many of these engineers are serving as maintenance foremen and supervisors. The maintenance of continuous equipment requires a knowledge of process and production equip-

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We would welcome the opportunity to tell you our story—Call Jackson 3-5024, Atlanta, Ga. or write—

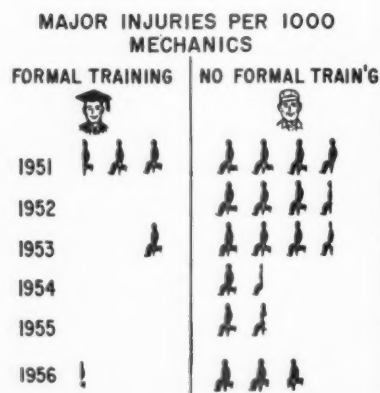


TENNESSEE CORPORATION
417-29 Grant Building, Atlanta, Georgia



SIGNIFICANCE OF TRAINING ON SAFETY PERFORMANCE

TRAINED MECHANICS WORK—
MORE SAFELY & MORE EFFECTIVELY



NO MAJOR INJURIES DURING 1954 AND 1955 TO THE 4000 MAINTENANCE MECHANICS TRAINED UNDER FORMAL PROGRAMS. 29 MAJOR INJURIES IN THIS PERIOD TO THE BALANCE OF THE MAINTENANCE FORCES.

JOB KNOWLEDGE MEANS EFFICIENCY—Above is chart showing how job knowledge contributes to safety and efficiency. The company's formal program started in 1951. Each figure on chart represents one injury per 1,000 mechanics. As can be seen, none of the 4,000 formally-trained mechanics was involved in a major injury during 1954 and 1955. The 10,000 other mechanics were involved in 29 major injuries during this period.

LESSONS FOR PLANT MECHANICS—At right are typical sheets showing lesson units for mechanics training in chemical production plant. Note the emphasis on "how to do it" instruction of practical nature.

MECHANICS TRAINING LESSON UNITS



ment, as well as specific "trade" knowledge.

Train Your Maintenance Men

The mechanics training programs are given to experienced mechanics to increase their knowledge of new equipment and to raise their level of effectiveness. We have determined that an average increase in labor effectiveness of 11% results from training.

The training program has also been used at new plants where trained personnel were not available. It has been possible within a four-month period to train their new, inexperienced men to maintain the plant satisfactorily.

We believe that an important contributor to safety is job knowledge. The accompanying illustration shows the effect of training on major injuries to mechanics. The formal company-wide program was started in 1951.

Each figure represents one injury per 1,000 mechanics. As can be seen, none of the 4,000 formally trained mechanics was involved in a major injury during 1954 and 1955. The 10,000 other mechanics were involved in 29 major injuries during this period.

Analyze Performance and Costs

This is the job of continuing self-criticism of our maintenance operations. We have found that, regardless of the plant size or process, maintenance responsibilities can be divided into four broad functions:

- Planning
- Work Load
- Cost
- Productivity

By close attention to these functions, maintenance costs may be reduced while at the same time efficiency may be stepped up. A lessening of downtime of equipment increases productivity.

Investigations have indicated that plants with limited procedures and controls and having no formal training programs will probably have a labor effectiveness of from 20% to 40%. Using good controls and procedures, however, along with mechanics training and measurement, the labor effectiveness will normally be in the range of 80% to 90%.

These accomplishments are enormously worth while, but are not easy. However, it has been done in many plants, and can be accomplished in scores of additional operations around the country. Engineered maintenance pays off!

Polyethylene Bag Is Described by Monsanto

ST. LOUIS, MO. — A valve-type polyethylene industrial bag which its makers say can be used interchangeably with paper bags on standard valve bagging equipment has been described by the plastic division of Monsanto Chemical Co.

The makers state that the new concept of bagging will eliminate the difficulty of heat-sealing plastic closure surface contaminated during filling with powdery or oily materials. The new closure is said to be suitable for packing ammonium nitrate and other moisture-sensitive materials.

The new self-closing valve type bag is the result of a series of engineering studies of various closure methods in cooperation with bag and machinery manufacturers. Tests conducted at Monsanto's Texas City plant, where the new bag was used to package polyethylene and standard equipment, showed that it filled and handled the same as conventional multiwall paper valve bags. In drop tests from six feet, there was no leakage of breakage, the company says.



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—National Safety Council

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In every field, there is always one particular brand that is so outstanding that it is head and shoulders above the competition. That is true of Davison Hi-Flo Gran-U-Lated Triple Superphosphate. Here is the product that is the standard of comparison for all other granulated triples. Davison Gran-U-Lated Triple Superphosphate is uniform in particle size... dust free and will not break down or crumble in the bag. It is ideal for direct application or for formulation of dry materials. Most of all, with Davison Gran-U-Lated you are certain of constant uniformity... it is **GUARANTEED 46% available P₂O₅**... every time.

A test carload will prove it to you. Simply call us today. The Davison Sales and Technical Representative will be happy to provide complete information.

W.R. GRACE & CO.
DAVISON CHEMICAL DIVISION
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NEWS DIGEST OF THE WEEK

Simplot Announces \$2 Million Expansion Program for Sulphuric Acid and Fertilizer

POCATELLO, IDAHO—A major expansion of its Pocatello fertilizer plant has been announced by the J.

R. Simplot Co. The expansion includes:

1. Construction, already under way,

of a new plant for the manufacture of sulphuric acid.

2. Building of an addition to the main plant to increase production by an estimated 65% to about 175,000 tons high analysis fertilizer annually.

W. Grant Kilbourne, general man-

ager of the Simplot Fertilizer and Mining Div., said that approximately \$2 million will be spent by the company on the expansion program. He said the 400-ton-per-day sulphuric acid plant will be in production by August as will the expanded facilities at the main fertilizer plant. The resulting increased fertilizer production will then be available for distribution.

Mr. Kilbourne emphasized that while the new additions are being made, the current production rate of phosphoric acid and triple superphosphate will be unaffected.

The company mines phosphate ore deposits at what is known as Gay Mine on the Ft. Hall Indian Reservation, the principal element in the manufacture of triple superphosphate, an agriculture fertilizer, which it manufactures and ships from its plant west of the city. It also furnishes the entire phosphate requirements of Westvaco Mineral Products Div., FMC, which manufactures elemental phosphorus in its plant near the Simplot facility.

Simplot has secured its sulphuric acid from the Bunker Hill Co.—large lead and zinc firm in Kellogg, Idaho.

"We have been unable to secure our full requirements of sulphuric acid from the Bunker Hill Co., however, and efforts to induce them to expand their sulphuric acid manufacturing facilities to take care of present and future needs have been unsuccessful," Mr. Kilbourne said.

"Extensive studies therefore dictated the construction of a sulphuric acid plant in conjunction with the present phosphate facilities, thereby assuring an adequate supply of acid at all times," he said.

Simplot will now purchase elemental sulphur produced in Montana and Wyoming oil and gas refineries. It will be shipped to Pocatello in molten form in tank cars and turned into sulphuric acid at the new plant.

Safety Officer Named

COLUMBUS, OHIO—George L. Pelton, chairman of the fertilizer section, National Safety Council, has been named assistant secretary of the Smith Agricultural Chemical Co. of Columbus. Mr. Pelton has been prominent in industry safety affairs for a number of years and has held responsible offices in the national organization of the fertilizer industry.



Geo. L. Pelton

Smith Agricultural named William F. Farley president and Marshall A. Smith vice president and general sales manager at the firm's annual meeting in January.

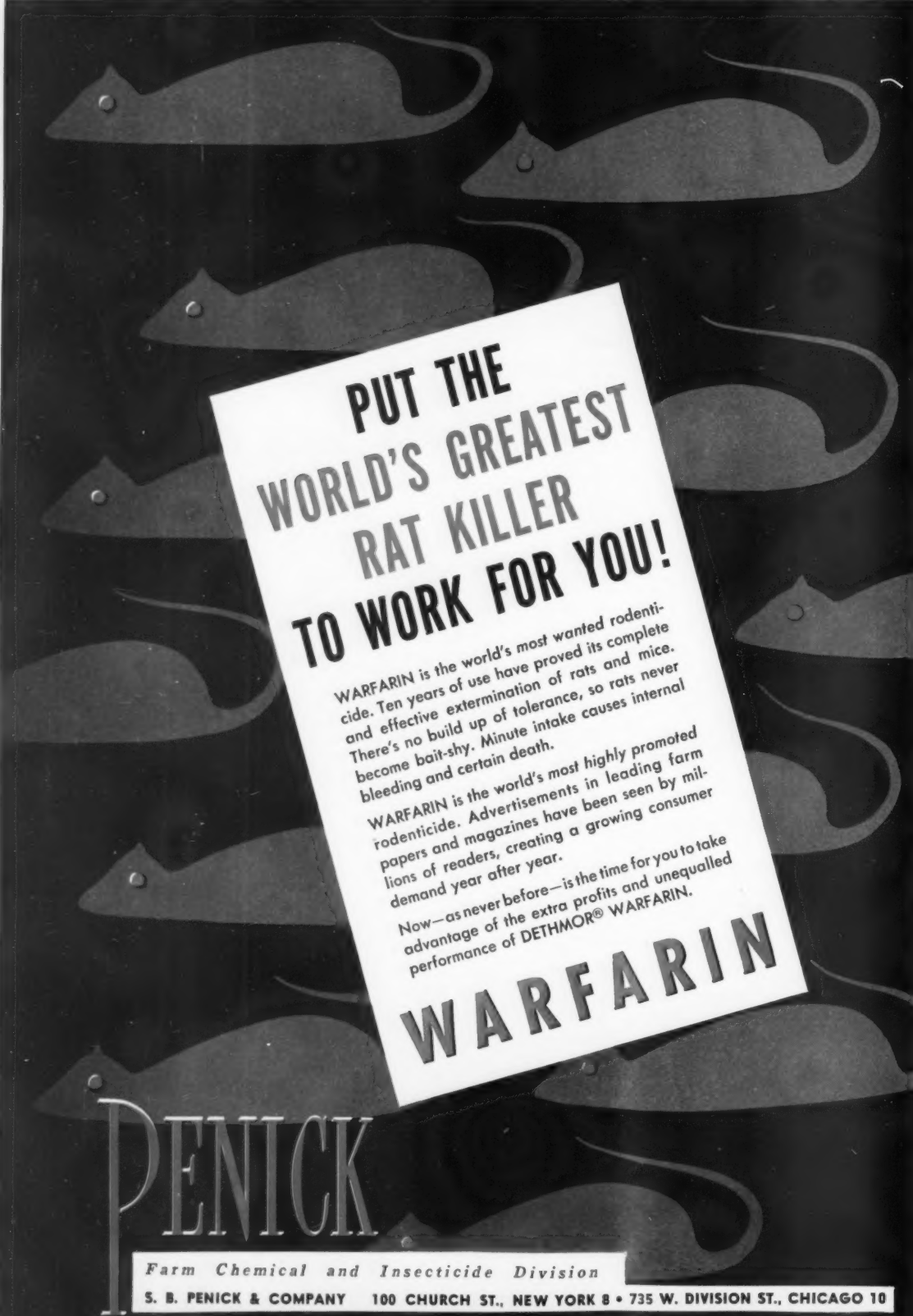
General Manager Named

SOUTH SIOUX CITY, NEB.—Crystal Chemical Co., Inc., South Sioux City, has announced the appointment of Lyle Barndt as general manager of the firm. Mr. Barndt was formerly plant manager of the Farmco Service plant at Prairie du Chien, Wis., a position he held for eight years. Before his association with Farmco, he was with the Tennessee Corp.



Lyle Barndt

The Crystal firm states his new work comprises that of coordinating activities of the firm's manufacture and distribution of pelleted fertilizer materials as well as the distribution of a complete line of agricultural chemicals and Gandy application equipment.



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LETTERS TO THE EDITOR

"Congratulations on your Production Edition! It's very readable and our people have found it extremely interesting."—Ed Ginn, manager, Agricultural Advertising, Hercules Powder Co., Wilmington, Del.

"All of us like your effort immensely . . . Our best wishes to you and your staff for the greatest success ever in this splendid creative idea."—Robert J. McDonald, sales manager, packaging service, Bemis Bro. Bag Co.

"Thank you very much for sending me a copy of your first Production Edition of Croplife. This is certainly an excellent publication and I know will fill a need in covering the production aspects of the pesticide and fertilizer industries."—Denis Hayley, director of information, National Agricultural Chemicals Assn., Washington, D.C.

"The Production Edition of Croplife is certainly a well-prepared publication and I was most interested in the subject matter which it contains. This certainly is a worthwhile edition, and I am sure will be well received by the industry."—H. H. Tucker, agricultural service director, Sohio Chemical Co., Lima, Ohio.

"Thanks for the first Production Edition of Croplife. I very much enjoyed this issue and found it most helpful. I thought the article on insecticide formulation of liquids was particularly good and I am looking forward to seeing the next issue."—Melvin Goldberg, Pesticide Advisory Service, New York.

"We have read your first Production Issue and find it most interesting. Our viewpoint may be a selfish one, but we are glad to see one of the leading trade journals devoting so much space to the manufacturing and equipment problems that are now facing the fertilizer industry. We believe that great good could be accomplished by comprehensive articles written by responsible equipment and process men to help educate the average fertilizer plant operator to some of the present day problems."—Harold R. Krueger, sales engineer, Stedman Foundry and Machine Co., Inc., Aurora, Ind.

"With the changes in the fertilizer manufacturing industry so numerous and so drastic, it seems to me that a Production Edition each four weeks would be a welcome change or addition. I am quite certain that if I were a fertilizer manufacturer, I would be looking for all the help and ideas that I could get that would enable me to do a more economical and efficient job of fertilizer production . . . It is a nice-looking book; one that should serve well both the reader and the advertiser."—Zenas H. Beers, regional director, National Plant Food Institute, Chicago.

"Very large congratulations on your first issue of the Production Edition of Croplife . . . Some of the articles are very, very fine; in particular, the one on formulation conversion data by William R. Lucas. I think this is the first time I have ever seen the published listing of the specific gravity for the various toxicants—not that it was not available, but simply

that no one ever bothered to publish it.

"I will be very interested to hear your reports regarding the general reception of this and following is-

sues, since in the past, no one appears to have had the intestinal fortitude of publishing what has been heretofore considered 'trade secrets.'"—Joseph P. McKenna, manager, Fluid Energy Processing & Equipment Co., Philadelphia, Pa.

"The first copy of the Production Edition of Croplife is certainly a credit to you and your organization. We were delighted to receive it . . . The magazine should have a ready acceptance and should become very popular as it contains a great deal of much-needed information for the management and production group you reach. Best wishes for its continued success."—Emil C. Gerdes, E. C. Gerdes Co., Minneapolis, Minn.

"We have just received your first issue of the new Croplife Production Edition and feel that you and your staff have done an outstanding job."—John E. Fletcher, vice president, U.S. Potash Co., division, United

States Borax & Chemical Co., New York.

"Congratulations on the first issue of your Production Edition. It must be a fine satisfaction to you to have succeeded in bringing out this new edition. I wish you much success in your coming issues of the Production Edition."—Dr. Vincent Sauchelli, chemical technologist, National Plant Food Institute, Washington, D.C.

"I received your initial copy of the Production Edition of Croplife along with many of my co-workers. It was a very interesting issue and I am sure it will have a lot of appeal for people in the production end of the fertilizer business as well as those who are calling on them in a sales capacity. My congratulations to you and your organization and my best wishes for continued success with your Production Edition."—W. T. Dible, In-

Turn to LETTERS page 31

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Urea — Ammonium Nitrate — Ammonia Solutions	Urea — Ammonium Nitrate Solutions
<p>Sohiogen 4119 Sohiogen 4425 Sohiogen 4428 Sohiogen 4933</p> <p>Ammonium nitrate nitrogen solutions containing 6 to 15% urea to:</p> <ol style="list-style-type: none"> 1. lower salting out temperatures of solutions 2. improve granulation 3. help condition mixed goods 	<p>Sohiogen 2800 Sohiogen 3200</p> <p>28 and 32% nitrogen solutions containing no free ammonia — ideal for surface and sub-surface application — as materials and in complete liquid fertilizers</p>

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COMMUNITY RELATIONS AT STAKE . . .

Air Pollution Problem Tough for Fertilizer, Pesticide Operators

By H. F. Roderick

Formerly Vice President, International Minerals & Chemical Corp.
Now with Miles Laboratories

INDUSTRY's participation in air pollution programs must be as an equal partner with the community's government, health and social groups in working toward a solution. Indus-

try must be put in a position where it can contribute, and contribute something more than its neck.

In turn, it must recognize that it has a responsibility to the public to

keep it informed of the work being done in the public interest. If an honest and diligent effort is made to keep the public informed, the reward will be public confidence and patience which permits the painstaking work of research to continue.

This has been the experience of the phosphate industry in Florida. It is a timely story in the sense that industry's efforts in that area are still going on. There has been marked progress there compared with what happened in the past. For these reasons and because it illustrates a pattern of industry-community cooperation, the experience is perhaps worth relating.

The phosphate mining area of Florida is in Polk County, in the central part of the state, about 20 miles east of Tampa. The principal occupations of the area, other than phosphate mining, are citrus fruit and cattle growing. It is the most productive citrus area of the state. It is also one of the world's richest phosphate areas. It produces more than 70% of the nation's output and about 30% of the world's supply.

Production of phosphate rock in Florida has increased in 10 years from six million tons of phosphate rock to more than 10 million tons . . . an increase of approximately 70%.

The phosphate rock is strip-mined from 15 to 30 feet below the earth's surface and piped in a slurry to refineries. There it is dried and processed and shipped out in various forms, principally as fertilizer materials. In the drying and handling, considerable dust is raised which is collected by cyclone collectors, precipitators and bag collectors.

A more recent development in the area is the production of phosphate chemicals from processed phosphate rock. Triple superphosphate is one of the chemical products. Prior to 1943, there were only one or two producers of triple superphosphate in the area. Now there are nine. In that relatively short period, production of triple superphosphate has increased to the point where Florida now supplies more than 80% of the nation's production of triple superphosphate.

This growth of production was a reflection of what was happening as a general pattern all over the country. The population was growing and Florida is one of the fastest growing states in the nation. Central Florida, the area we are talking about, has had a population growth equal to or better than the state's average.

As production grew and population in the phosphate area grew, so did complaints about air pollution. These objections came from citrus growers, flower and vegetable growers and cattle raisers. The basis for the complaints was alleged fluorine damage to crops and fluorosis in cattle. There was a time two years ago when you rarely picked up an edition of the newspapers in the area when someone wasn't directing a charge against the phosphate companies.

Finally, in June, 1955, the Florida State Legislature created a joint committee on air pollution which conducted five hearings, several of them public hearings in Polk County. The result was passage of an air pollution law, by the State Legislature in 1957, creating an air pollution commission. The commission has nine members, two of them representing the industry.

By this time, several damage suits were filed against the phosphate companies.

What were they doing all this time to handle the problem?

Let me say at the outset that the phosphate companies recognize that they have a responsibility to act as good citizens just as any individual has and to conduct their operations safely and with all reasonable protective measures, so as not to injure their neighbors. In my opinion, they



H. F. Roderick

are taking the necessary steps to discharge this responsibility.

International Minerals & Chemical Corp., the largest operator in the field, had been conducting effluent control measures from the start-up of its plants. The firm has now introduced improved equipment to the extent that by next July it will have in excess of \$3 million worth of the most modern waste control equipment in operation. About a million of this will be spent on the triple superphosphate plant.

I would estimate that the phosphate industry in Polk County has about \$6 million invested in effluent control equipment. In addition, it costs one company a quarter of a million dollars annually to operate its control program.

Starting in 1955, in its research laboratory, IMC undertook leaf sampling and evaluation studies to determine the cause and nature of alleged crop damage in an effort to determine to what extent the phosphate companies might be responsible. In the next three years, International spent nearly \$300,000 on these studies.

From close observation, or actual experience, with air pollution research work, you begin to appreciate the tedious, tireless effort it takes. In one period of 90 days, our researchers, conducting leaf sampling, covered an 800 square mile area.

We didn't know then, but we do now, that this was pioneer work on air pollution damage to citrus crops we were conducting.

We have since come to appreciate how little is known about air pollution damage, the levels of toxicity, the effects of temperature, wind, soil, rainfall and a dozen other variables.

We have learned that the findings on air pollution in one area do not necessarily apply to another. And that much research money and effort must be expended in providing a control base on which to judge findings or samplings.

If the Florida phosphate industry had been guilty of anything up to this point, it was failure in two respects.

(1) Failure to recognize that the public regarded the alleged air pollution as an industry matter. No matter how good any one company's control program was, the complaints were lodged against the "phosphate companies" in total.

Failing to recognize this, the companies did not organize as an industry group.

(2) The second failure at this time was failure to keep the public informed of the work the industry had done on effluent control. If the phosphate companies had taken the public into their confidence, they could have gained the public understanding and patience they needed to carry on their research efforts.

Both steps have since been accom-



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plished by an organized industry group with significant results.

A Florida Phosphate Producers Committee was formed initially to represent the six participating members before the hearings of the state legislative committee. It has since become a permanent organization with a two-fold program covering research and public relations.

Resources Research, Inc., of Washington, has been retained to conduct expert and impartial scientific research into the causes and effects of alleged air pollution in Polk County. Dr. Louis McCabe, president of the organization, who has had extensive experience as the first director of the Los Angeles Control District and in federal government control work, is directing the research program. A new field laboratory has been established in Polk County, Florida, to conduct extensive field studies.

A capable local public relations firm in Polk County has been retained to counsel and direct the Florida Producers public relations program.

This program, in the last six months, has gained better understanding for the phosphate industry's problems than has ever existed before in that area. Our industry recognizes that it is receiving an expression of public confidence and good will, which it must respect.

The first step undertaken by public relations was to announce the Florida producers' two-fold program at a meeting where newsmen could meet and question Dr. McCabe. This story received prominent attention in the press.

Since then, Dr. McCabe has appeared on planned programs before local service groups to describe this work. These appearances have served as devices for reporting to the public additional aspects of his program.

Meanwhile, the industry continues to gain greater public understanding and appreciation as a result of stories sketching its economic importance to the state and community.

While the final outcome of this effort is yet to be judged, I think the results so far are significant.

It is evident that a soundly directed scientific search for the real facts on air pollution will attract industry's whole-hearted participation. Industry has two impelling reasons to contribute to such a program:

- (1) The increasing need to demonstrate openly the regard it has for its responsibilities in this area, and
- (2) Its profit requirement.

Practically everything that is carried off in the air stream represents an economic loss to industry.

For its part industry needs to organize its pollution, research and control efforts, which are costing millions, so that they become a massive move toward a permanent solution. Having taken this step, industry needs to inform people of its program. When it does, it gains an understanding ally.

Air, Water Pollution Conference Scheduled

WASHINGTON—Two years of progress in water and air pollution abatement by the chemical industry will be demonstrated on the program of a two-day conference sponsored by the Manufacturing Chemists' Assn. March 18-19 at the Netherlands Hilton Hotel, Cincinnati, Ohio.

The conference, similar to one held two years ago, has been arranged primarily for chemical manufacturing companies, pollution research specialists and representatives of federal and state agencies, although registration is open to all interested persons. The MCA's air and water pollution abatement committees first began sponsoring such conferences 17 years ago.

Vernon Stack, Jr., of Union Carbide Chemicals Co.; J. C. Lamb of

American Cyanamid Co.; W. M. Steinfeldt of Eastman Kodak Co., and J. T. Garrett, Monsanto Chemical Co. will discuss the choice of equipment for biological oxidation, and describe activated sludge aeration and the use of stabilization basins.

On the afternoon sessions March 18, C. W. Gruber, Cincinnati, will talk on that city's air pollution control program. Three technical papers will follow, including "The Odor Survey—a Tool for Air Pollution Control" by A. N. Heller, Allied Chemical Corp.; "Demisters for Sulfuric Acid Plants" by O. D. Massey, Stauffer Chemical Co., and "Mist Collection with Fiber Beds" by J. A. Brink, Jr., Monsanto.

The March 19 program will include consideration of specific water pollution abatement problems including the incineration of solid wastes to be discussed by Charles Sercu and T. J. Powers, Dow Chemical Co.

MIXTURES

Continued from page 8

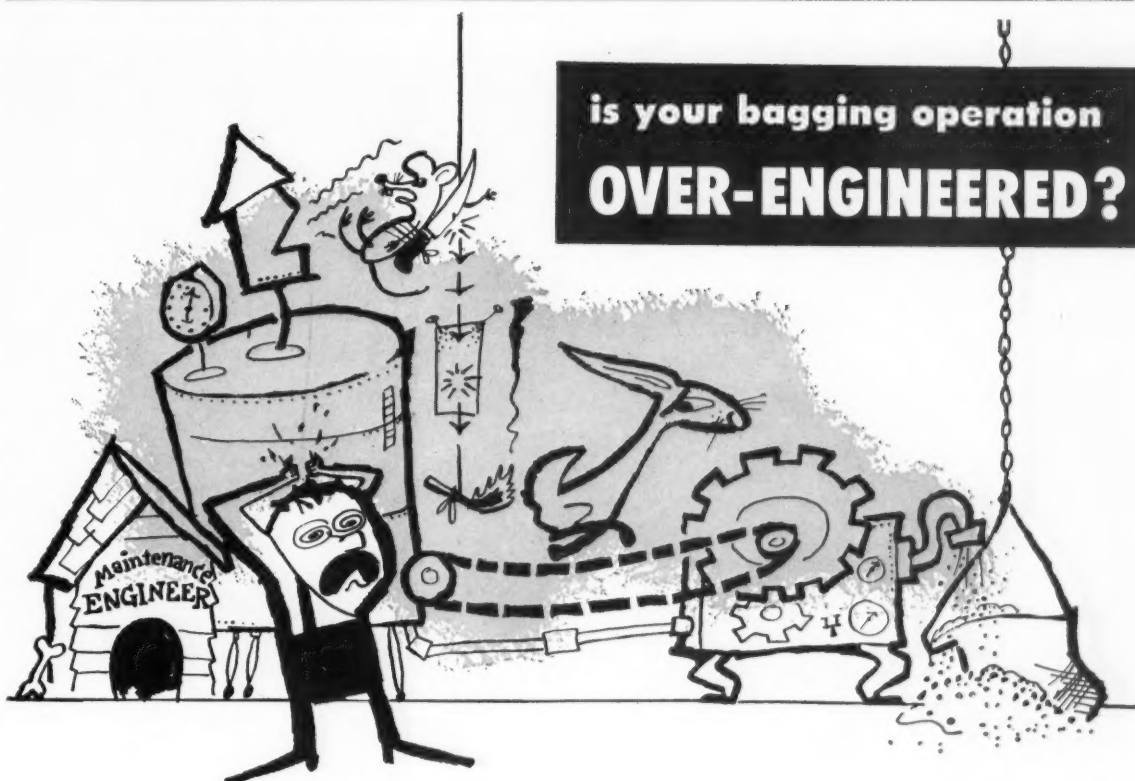
the wrong crop, the results could be disastrous.

It is of extreme importance that mixtures be kept fully labeled and that they be stored in places where they will not contaminate adjacent mixes either by leakage, spillage or by vapors. To minimize this type of hazard, some firms prepare fertilizer-pesticide mixtures only on order and for immediate shipment.

The hazards involved during application of these mixtures involve the protection of workmen and the possibility of misuse. These must be recognized by the manufacturer in preparing complete and adequate precautionary labeling of the material. For protection of workmen, the label-

ing must not only show precautions similar to those observed in the mixing plant, but the hazards of misuse must be met by including information concerning the application itself.

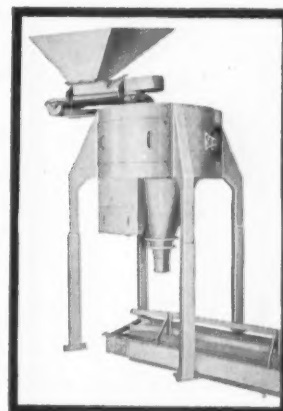
Production people are naturally interested in the hazards that exist in mixing plants, but it is well also to consider the hazards that continue to exist after these materials leave the plant. Some of these pertain to dealers, farmers and pest control operators and one should be fully aware of these later hazards in order to prepare adequate precautionary labeling for each container. A typical precautionary statement on the labeling of some of the



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pesticide-fertilizer mixtures is as follows:

"CAUTION!"

Avoid prolonged or repeated inhalation of dust or contact with skin.

Wash with soap and water after handling and before eating or smoking.

In case of contact with skin or eyes, flush with plenty of water; for eyes, get medical attention.

Wear clean clothing."

Labeling of such mixtures usually includes additional precautions such as the following:

"Do not apply or allow to drift to areas occupied by unprotected humans, livestock, or honeybees."

Some of the pesticides used in these mixtures are of sufficiently high tox-

icity that amounts drifting onto people, or the areas where people may later be, onto forage, or onto blossoming crops, may cause injury. Furthermore, even though the amount that drifts might not cause serious injury to livestock or dairy animals, it might contaminate their meat or milk. One of the most difficult problems facing agricultural pest control in California at the present time involves the possible drift of persistent chlorinated hydrocarbons onto feed crops and the subsequent concentration of the chemicals in milk and meat.

Other precautions to be remembered are included in these additional warnings:

"Do not permit this material to contaminate streams, lakes or ponds where it might injure fish and wildlife."

"Use this material only for the

recommended purposes and at the recommended dosages."

The development of dual-purpose mixtures of pesticides and fertilizers is just one aspect of the way in which these two categories of materials are growing together. This field is becoming enormously complicated by the fact that some fertilizers themselves may have some pesticidal value and that some pesticides themselves may have some fertilizer value. In addition, there are being developed and marketed a number of new chemicals for new agricultural uses and in some cases it is becoming difficult to say whether these materials are being used for fertilizer purposes or pesticide purposes.

It is evident that a number of changes are going to be made in laws of various states to adapt them to current developments, and a number of organizations are currently working on ways of handling this problem satisfactorily and uniformly on a national basis.

Southern Nitrogen Announces Large Expansion Program

SAVANNAH, GA.—A multi-million dollar expansion has been announced by Southern Nitrogen Co., involving its ammonia production. According to John R. Riley, president, the ammonia plant at Savannah will be expanded 20 to 25% at a capital investment of \$500,000. In addition, he reports, the firm is now in production in Savannah on a solid nitrogen material containing 20.5% nitrogen plus dolomitic limestone. "This new product will augment our 33.5% 'Dixie' nitrogen products," he said.

Mr. Riley also announced plans to begin construction immediately on a new plant near Tampa, Fla. Details of the new installation were made known by George V. Taylor, president of Florida Nitrogen Co., new and wholly-owned subsidiary of Southern Nitrogen Co.

Mr. Taylor said that the new plant will cost \$3 million. It will draw its ammonia from the Southern Nitrogen Co. plant in Savannah. The Tampa plant will include facilities to produce solid 20.5% lime nitrate and a full line of nitrogen solutions for agriculture and industry. At the same time, construction will begin on a plant to produce nitric acid. Plans also call for the completion of an ammonia plant at a later date. This three stage plan of development will call for a total investment of about \$7 million.

When completed, the entire plant will employ about 100 people and have a payroll of approximately \$600,000, according to Mr. Taylor. It will be located on a 25 acre tract about six miles east of downtown Tampa. It will use, daily, about 5 million cu. ft. natural gas, 250,000 gal. water, and 108,000 kilowatt hrs. electricity.

Florida Nitrogen Co. will produce a complete line of nitrogen solutions for fertilizer manufacturing and direct application to the soil, solid 20.5% lime nitrate material for manufacturing and direct application, and various industrial nitrogen products for a variety of applications, Mr. Taylor said.

Since Florida Nitrogen Co. will have the only nitrogen plant in central and south Florida, Mr. Taylor pointed out that it will provide a dependable, year round nitrogen source and bring substantial freight savings to Florida agriculture.


Mr. Taylor announced that Florida Nitrogen Co.'s resident officials are R. G. Riley, vice president; Philip J. Fleming, sales manager, and N. F. Maddux, plant manager.

New Plant Superintendent

OLATHE, KANSAS—W. H. Mullins has been made superintendent at the recently-acquired American Agricultural Chemical Co. plant here. He was formerly foreman at the Seymour, Ind., plant. Replacing Mr. Mullins at the Seymour plant is W. K. Stone, formerly located at Greensboro, N.C. The announcement was made by R. M. Richey, general superintendent.

Watch Out for . . . MOISTURE CONTENT

When using ammoniating solutions, the moisture content of the superphosphate may be less important than otherwise. If the total moisture content of the mix reaches the point at which the mix becomes muddy, ammonia absorption may be poor, reminds T. P. Hignett, Tennessee Valley Authority.



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Safe and Efficient Practices Solve Granulation Problems

By Elmer C. Perrine
Nitrogen Division
Allied Chemical Corp.

Part II

EDITOR'S NOTE: Part I of Mr. Perrine's article on fertilizer granulation appeared beginning on page 1 of the Jan. 19 Croplife Production Edition.

Today the liquid phase, or plasticity for granulation, is being achieved sometimes at less than 5% total water but with temperatures at 230° and 240° F. in the mixers. At these temperatures and low water content, there is not much latitude for error. It is a serious matter when the entire mass in a mixer becomes unbalanced by failure of recycle flow, water, or sometimes by the complete stoppage of all dry ingredients while the flow of acid and nitrogen solutions continues unabated.

There are few plants that have exploited all of the other and safer possibilities for economy in granulation, and until this is done a long look should be taken before the primrose path is taken through more intensive chemical activities with less water in equipment, and in processes that were ill-designed for the chemical processing that is actually being demanded of some of them. Even when and if it becomes desirable to resort to the extremes, even these extremes can be very much safer and more productive if all of the other possibilities for increased production are instituted beforehand. Some of these features are quite productive of results and more of them should be incorporated in the original equipment rather than by the more costly corrective measures taken later.

Many dryers cannot perform nearly to their capacity because of large leaks that deprive them of much of the air they need. This also overloads the dust collection with air that has done no work. The by-passing of much air from the dryer results in forcing the burner to do much of the work that the air was expected to do—a very unsatisfactory substitution. It results in extreme temperature of the product—especially in the few feet of the end of the dryer. This sometimes deteriorates the physical and chemical quality of the product that may have been quite satisfactory before it reached the needlessly intense flame of the burner.

Where any product is recycled this should be proportioned about as accurately as all other ingredients in the mass, for any material in the mass contributes its influence to granulation in some manner and this influence should be unvarying. Not only does controlled recycle add measurably to effective granulation; in many instances it may be about as necessary for safety in the high intensity operations as any other single factor if the original operations did, in fact, take any recycle into account.

Some equipment, more generally the continuous mixers, is provided with an interlock that stops the flow of acid and nitrogen solution automatically when there is an interruption of flow of the dry materials and they are very effective. It is not a

costly nor difficult task to add these interlocks to existing equipment. Some such precautions could well be applied to the many batch operations thereby placing less dependence on the operator.

The use of ammeters to indicate the load in the rotary batch mixer is one inexpensive device for lessening the

chances of the operator's being caught unaware that there is little or no dry material in the mixer.

Safety as well as costs of operation would doubtless be improved if some device were installed that would make it impossible or very difficult for the operator to increase the amount of acid beyond the written formula without the knowledge of some one who is aware of the consequences of an indiscriminate use of sulfuric acid. Usually there is some moderation exercised in the use of nitrogen solutions but there is room for much questioning in some nitrogen losses where excessive amounts of acid are involved.

The ammonia take-up of most superphosphates is widely known and can be readily determined for any lot of superphosphate and for any equipment. In granulation the heat of reaction of the ammonia with superphosphate is a valuable asset that

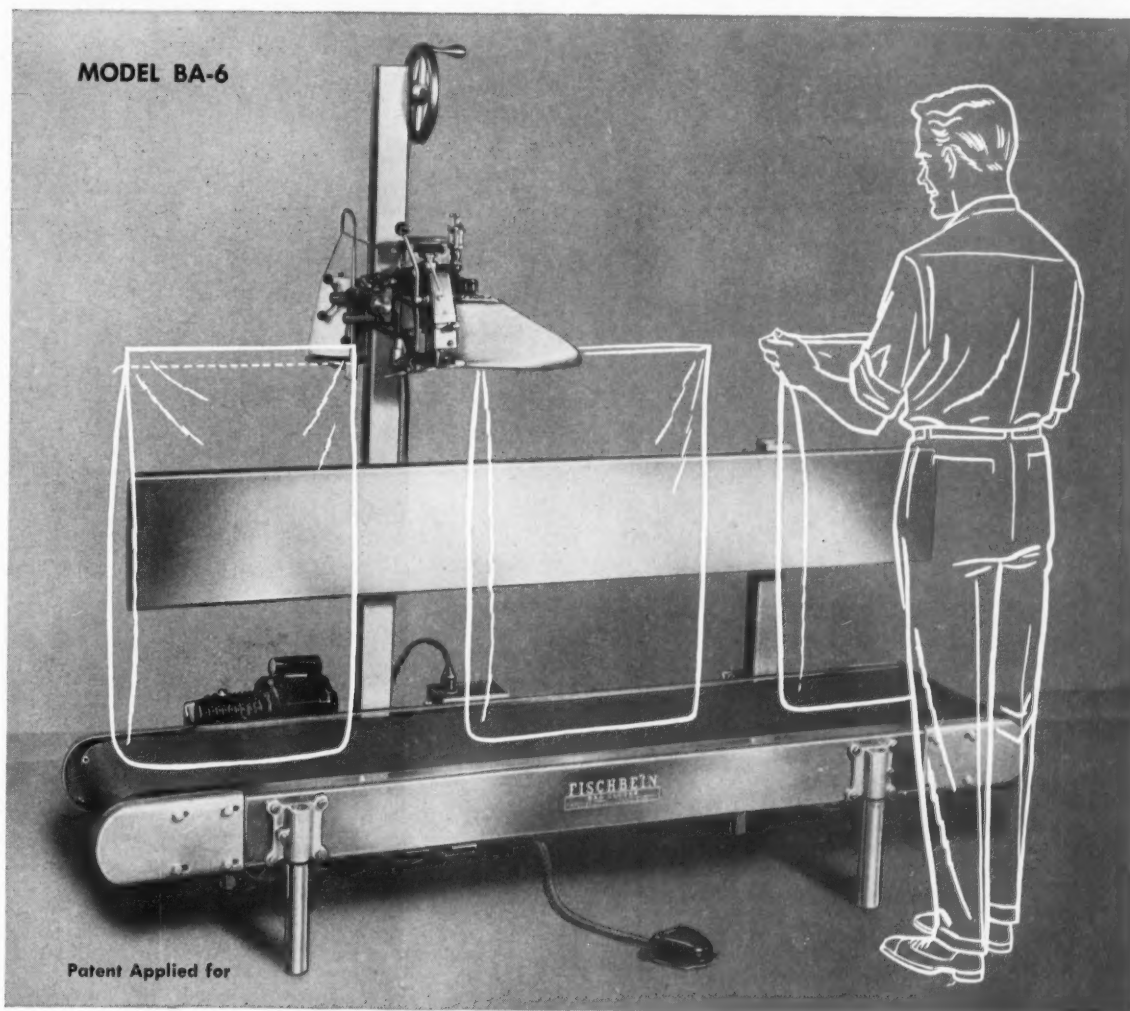
can be considered as free, since the nitrogen and the superphosphates have paid their full way as plant foods. When all of this potential heat is used the formula is also carrying the maximum amount of low cost nitrogen. Management is quick to question operations for any shortage of other ingredients and should be doubly quick to question the excessive use of sulfuric acid. Here possible danger is being added to unusual costs.

Ammoniation is a subject for extensive discussion and most suppliers of ammoniating media and equipment are capable of demonstrating very effective use of their products.

Formerly an inefficient use of ammoniating media resulted only in higher costs and poor working conditions. Now, if ammoniation of superphosphates and even of added acid

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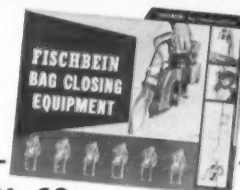
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is poorly performed there may be added to these losses the prospects of fires or even explosions in the mixers in extreme cases. The necessity for uniform distribution of the added acid and ammoniating medium for efficient use of both has been demonstrated in the ammoniation of superphosphates. Many operators miss this point and merely increase the use of acid to offset what is often deterioration of the distribution pipes, a costly and sometimes dangerous alternative.

As competition stiffens and the basic principles of granulation become more widely accepted, management is asking questions regarding all costs of producing their products. Quite elaborate records are maintained in some granulation plants. Perhaps two more records are needed. They are:

1. How much did all ingredients cost that went into the last ton of the run?

2. And why?

ACCIDENT PRONENESS

Continued from page 14

dents into either anger or fear. They classed their subjects by response to the test in three groups. (1) Those who became angry at the examiners. This group they termed "anger out." (2) Those who became angry at themselves and not the examiners because of ridiculous errors they themselves made. This group was termed "anger in." (3) Those who became anxious or apprehensive or frightened.

"Anger in" produced a significantly higher pulse rate than "anger out." Anxiety produced a significantly higher pulse rate and a higher pulse pressure than "anger out." The behavior of the "anger in" group with respect to pulse rate and pulse pressures was more like that of the anxiety group than it was like the "anger out"

group. These studies, therefore, show that anxiety or soreness at oneself can produce changes in pulse rate and pulse pressure which could result in low blood pressure scores.

What is the significance of these observations in the study of accident proneness? It is this—all of the factors which lead to abnormal blood pressure scores can affect any one of us at any time. We may be subject to disease, infection, or more serious conditions. We may have family worries, sick relatives at home, financial troubles. We may have inadvertently over-exercised, or over-exposed ourselves to extremes of temperatures during a weekend.

For many reasons, not pertaining to our plant activities, we may have

been deprived of necessary sleep. We may be exposed to annoying situations in our plants. We may even be exposed to hazardous chemicals.

If, while we are suffering from the physiological effects of these stresses, we should be placed in a hazardous situation or in a situation which we ourselves could make hazardous then we are liable to an accident. An accident occurs when a vulnerable individual meets a hazardous situation. During the course of our lives, there must be many occasions in which each of us is vulnerable. The fact that we do not meet a hazardous situation reduces our liability to accident.

If these physiological conditions, which make us vulnerable, can occur to all of us, then it is improper to use such a term as "accident proneness" either as a permanent stigma of an individual or as an explanation of the occurrence of accidents.

We are concerned with reducing the incidence of accidents of all degrees of severity. It is ridiculous to assume because, on the criteria used for competitive purposes, some of us may have a good record that it necessarily follows that we do not have accidents in our plants.

The seriousness of the outcome of an accident is more related to the hazardous situation than it is to the vulnerability of the worker. In many industries, the law of diminishing returns has come into play and we can make very little more progress merely by attending to the safety of equipment. Therefore, we must study the worker. We must study him from the point of view of the physiologist—not merely from that of the psychiatrist or psychologist.

There are many indications that deviations of bodily function are as controlling of mental attitude as mental attitude can be controlling of bodily function. Even though anger or frustration, or soreness at oneself or at others, may be a factor in many accidents, there may well be pertinent physiological conditions underlying these feelings of anger, frustration or soreness.

The physiological aspect of liability to accidents has received very little study except in relationship to efficiency of production and to so-called "industrial fatigue." Yet it would seem that an adequate study of the physiology of the workers who appear to be afflicted with multiple accidents might disclose a cause and a method of rehabilitation. This would reduce both the incidence of injury with its attendant costs and the risk of depriving ourselves of valuable workers through calling them "accident prone."

An accident occurs when a vulnerable individual meets a hazardous situation. The elimination of the hazardous situation is the business of the safety engineer. The vulnerability of the individual is the concern of the industrial physician. It is most particularly his concern when an individual, by sustaining multiple accidents, demonstrates frequent or continuous vulnerability.

To Expand Plant

MARYSVILLE, OHIO—Expansion to double its fertilizer production capacity has been announced by Scotts Chemical Plant, Inc., an affiliate of O. M. Scott & Sons Co., seed firm.

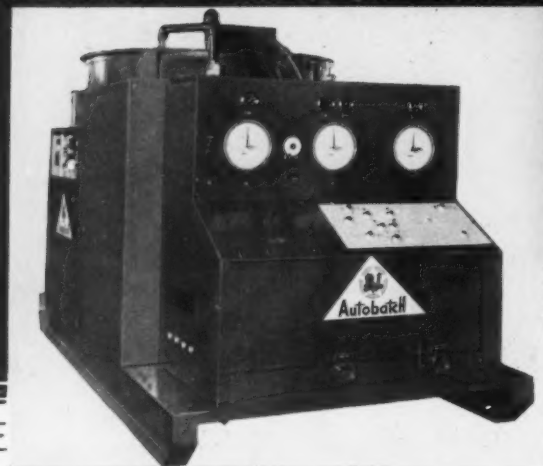
The expansion program will cost an estimated \$2 million, the company has announced. In addition to larger facilities for making fertilizer, the new buildings will increase its capacity for pesticide manufacturing and will centralize shipping operations for both seed and chemical plants.

Expansion is being financed by a new issue of \$2 million of Scotts Chemical Plant, Inc., 18-year 6% secured sinking fund debentures.

Scotts Chemical Plant, Inc., began operations in January, 1957. By the summer of 1958 it was producing at 140% of capacity and still could not keep pace with orders, according to the company.

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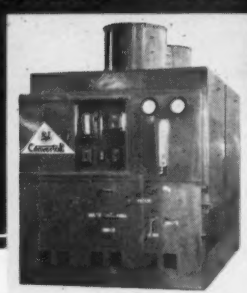
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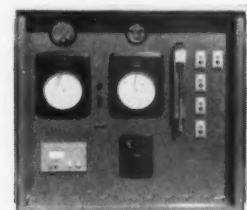
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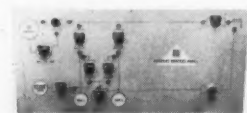
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DILUENTS

Continued from page 2

liquid impregnation and solid grinding processes. Formulation of the organics has evolved a new concept or approach in which the technical (nominally 100%) chemical is often first made into a concentrate or base material utilizing inerts with high sorptive capacity (carrier); and the base is then "let down" or extended to field strength dust with additional inert (diluent).

Flowability Required

Carriers and diluents are required to impart flowability to pesticide formulations. Dusts must flow freely and evenly out of the hopper and through the fan, tubes, and nozzles in order to achieve the uniform distribution, highly essential to the efficient field use of the active ingredient. In addition, good dustability—or tendency of the dust to permeate foliage and be deposited on all plant surfaces—is essential.

The density of a carrier or diluent is expressed as true density, apparent density and bulk density, often indiscriminately. By whatever name, this property is usually chosen so that there will be little or no segregation of ingredients in the dust mixture after it passes through the dust-er. Bulk density or volume-weight may also control the rate of discharge of dusting equipment. Its effect upon package design is, of course, evident.

Commercial insecticide dusts and powders vary from 85% to 100% by weight finer than 325 mesh, and diluent materials should fall within this particle size range to keep over-all grinding costs to the minimum. Although fineness is known to affect dust drift and settling, spray nozzle clogging, and possibly biological efficiency, the exact relationship is not clearly defined by work done to date.

Wettability and suspensibility are characteristics associated with wettable powder spray formulations. The hydrophylic properties of the carrier determine its wetting rate in aqueous dispersions. This property is thought to depend more on the character of the material's surface rather than the amount of its surface area. Suspensibility, on the other hand, is dependent upon the true and apparent density of the carrier as well as its particle size and shape characteristics. Surface active agents of various types are frequently utilized to improve both the wettability and suspensibility of spray powder formulations.

The abrasiveness of a carrier or diluent will, of course, largely determine the amount of wear on processing and application machinery. Lowest possible abrasiveness is desirable in wettable powder formulations to protect expensive spray pumps and nozzles.

The moisture content of mineral carriers or diluents can be divided into two categories—free moisture and combined moisture. Combined moisture—sometimes called constitutional moisture—is that which is chemically associated with the mineral in the lattice. Free moisture, on the other hand, is present on the surface of these materials as a result of atmospheric exposure and is expressed simply as weight loss after drying at 100-110° C.

Theoretically, lowest possible free moisture content of the carrier or diluent is most desirable. As a practical matter, varying small amounts of moisture are accepted, provided flowability, dustability, and sorptivity are not adversely affected.

New Address for Huber

NEW YORK—J. M. Huber has moved to 630 Third Ave. from its former address on Park Ave., the company announces. The telephone number is YUkon 6-8484.

Western Firm Buys Manufacturing Plant

PORTLAND, ORE.—Great Western Chemical Co., Portland and Seattle, has acquired a 60,000 sq. ft. industrial plant in Portland. Great Western is regional distributor of agricultural and industrial chemicals. The chemical firm's affiliate, Great Western Properties, Inc., was actual purchaser, paying \$400,000 for the modern plant. The purchase was made from Electric Storage Battery Co. of Philadelphia, which built the plant in 1947 for manufacture of storage batteries.

The reinforced concrete building includes 5,000 sq. ft. of office space. It is protected by a sprinkler system and is served by a terminal company spur track accommodating ten rail cars.

William Calder McCall is president and Richard H. Wilson, vice president and general manager of Great Western Properties and Great

Western Chemical Co., which will move to a newly purchased plant from its present quarters.

Great Western maintains affiliate operations in Eugene, Pendleton, Seattle and Spokane, representing a total of more than 50 chemical manufacturing concerns.

15 Agrico Plants Get Certificates for No Lost Time Accidents

NEW YORK—Fifteen of the 36 plants operated by the American Agricultural Chemical Co. have received safety certificates covering the calendar year for 1958, for completing the year with no lost time injuries, according to G. H. Mueller, safety director for the company, manufacturer of Agrico fertilizers.

The Spartanburg, S.C., plant, of

which J. E. Martin is superintendent, has achieved six consecutive years without a lost time accident.

The Henderson, S.C., plant, with S. B. Harris as superintendent, has reached the five year mark.

Three others plants—at Cleveland, Ohio; Columbia, S.C.; and Norfolk, Va., have received the award for three consecutive years.

The Alexandria, Va.; Baltimore, Md.; and Cincinnati, Ohio, plants have achieved two calendar years without a lost time accident.

Other plants that operated for calendar 1958 without a lost time accident are located at Buffalo, N.Y.; Cairo, Ohio; Danville, Ill.; Pensacola, Fla.; Port Hope, Ont.; Saginaw, Mich.; and Three Rivers, N.Y.

SAFETY THOUGHT

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PRODUCTION

EDITION

Editorial

Industry Taking Steps to Reduce Fumes and Gases Toward Halting All Pollution of Air

ONE of the most effective destroyers of public relations in the chemical industry is the real or fancied presence of fumes, gases, or dust emanating from plants into neighboring residential communities. Air pollution is a matter of much concern at the present time in many areas, although, of course, some communities are more conscious of it than others.

In a recent talk on the subject, Howard F. Roderick, formerly vice president of International Minerals & Chemical Corp. and now with the Miles Laboratories organization, said that industry is now in a better position than ever to contribute to the national air pollution control effort as a result of scientific findings. (The major portion of his talk is published in this edition of Croplife.)

Mr. Roderick points out that after years of being regarded as the sole culprit in the matter of air pollution, the chemical industry is now found to be "no more at fault than some of its principal accusers."

He adds that open fires, fumes from automobile motors, and other acts on the part of the public at large contribute to the situation, in addition to the presence of plant pollen and debris. The total contribution from all these causes amounts to "far more air pollution than what is usually ascribed to industry," he says.

Of particular interest to the industry, of course, is the fact that scientific evidence is beginning to clear the air, in more ways than one, of the unfounded charges, irresponsible statements and the miscalculated guesses made in times past.

"One of the major follies of some of our air pollution efforts in the past has been the time spent in finding fault with each other on the basis of limited evidence," he said. "The big hope, and the one in which industry can play a major role, is massing a major scientific effort on appraising and evaluating the causes and effects of air pollution."

"It will require a massive effort, because from the evidence mounting on all sides, it appears that what has been done so far is merely to scratch the surface. We are still in the pioneering stage," it was pointed out.

The industry is spending large sums annually to install and maintain air pollution control equipment in plants, and it is well known that even more should be done. But accomplishments of this magnitude do not come about in a hurry. The fact that telling efforts are being made in clean air research means that the time will certainly come when the fertilizer and pesticide industries will have earned complete confidence of their residential neighbors, even in areas where today the situation may be unfavorable.

Hard Hat, Short Sleeves, Safety Shoes and No Necktie Mark Worker as Safely Dressed

WHAT DOES the well-dressed plant employee wear these days? Probably not many style catalogs nor down-town window displays will give the answer, because the emphasis in the plant is on being practical and safe rather than showing off one's sartorial splendor.

Working in areas surrounded by various types of mechanical devices such as conveyor belts, pulleys, gears, rotary driers and various scoops and shovels demands alertness on the part of the worker and also a lack of floppy pant legs and sleeves that might get caught.

Neckties, sometimes considered the mark of well-dressed gents, are taboo around moving machinery. They have a fiendish way of rolling around shafts and pulling their wearers into the works. There are still other helpful things to remember along these lines.

Trouser legs should be about ankle length to keep them off the floor and out of the way. It is best to have the cuffs sewn up or cut off, since they might otherwise come down and cause the wearer to trip. And wearing ragged or frayed pant legs is also inviting trouble.

When temperatures permit it, short sleeves are safer than long ones, but in cooler

weather, a suitable jacket fastened securely at the wrist is not likely to get one entangled. Rolled-up sleeves, on the other hand, present flapping ends which are rolled into several thicknesses of cloth which can allow an arm to be pulled into machinery before the cloth tears. Full length sleeves are preferable, from the safety standpoint, in nearly all situations.

Fashion predictions have it that the derby is on its way back as a skypiece for men. But the lid that remains in fashion in the plant is the hard hat which protects its owner from many a bump and possible serious injury. The hat, of course, is of material which will not conduct electrical current.

At the other end, the well-dressed production man wears safety shoes as a recommended safeguard. Many are the testimonies of men who would be crippled today had they not been wearing these special shoes when something dropped on the foot.

Fertilizer and pesticide plants sometimes expose their people to various irritants. For protection against them, safety goggles and special clothing are recommended.

Good sense and a personal interest in self-preservation are strong arguments in favor of keeping these tips in mind.



Croplife's Home Office

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CROPLIFE is a controlled circulation journal published weekly. Weekly distribution of each issue is made to the fertilizer manufacturers, pesticide formulators and basic chemical manufacturers. In addition, the dealer-distributor-farm adviser segment of the agricultural chemical industry is covered on a regional (crop area) basis with a mailing schedule which covers consecutively, one each week, three geographic regions (South, Midwest and West) of the U.S. On the fourth week, production personnel in fertilizer manufacturing and pesticide formulating plants throughout the U.S. are covered in depth. To those not eligible for this controlled distribution, Croplife's subscription rate is \$5 for one year (\$8 a year outside the U.S.). Single copy price 25¢.

LAWRENCE A. LONG

Editor

DONALD NETH

Managing Editor

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Industry Meetings

Feb. 24-25—Alabama Pest Control Conference, Alabama Polytechnic Institute, W. G. Eden, Secretary-Treasurer, Alabama Association for Control of Economic Pests, Alabama Polytechnic Institute, Auburn, Ala.

March 4-5—Annual Weed and Insect Conference, Fonner Park, Grand Island, Neb.

March 17—Western Agricultural Chemicals Assn. spring meeting, Hotel Miramar, Santa Barbara, Cal.; C. O. Barnard, executive secretary.

March 18-19—Water and Air Pollution Abatement Conference, Netherland Hilton Hotel, Cincinnati, Ohio. Sponsor: Manufacturing Chemists' Assn.

June 9-10—Seventeenth Annual Convention of the Association of Southern Feed and Fertilizer Control

Officials, Velda Rose Motel, Hot Springs, Ark.; Maurice Rowe, Virginia Department of Agriculture, 1122 State Office Bldg., Richmond 19, Va.

June 14-17—National Plant Food Institute, Annual Convention, the Greenbrier, White Sulphur Springs, W. Va.

July 7-9—Pacific Northwest Plant Food Assn., 10th Annual Regional Fertilizer Conference, Tacoma, Wash.

Oct. 21-23—National Agricultural Chemicals Assn. 26th annual meeting, French Lick-Sheraton Hotel, French Lick, Ind.

Nov. 4-6—Fertilizer Industry Round Table, Mayflower Hotel, Washington, D.C.; Dr. Vincent Sauchelli, National Plant Food Institute, chairman.

meet the farmer's needs, more plant food elements included in the formulations, other agricultural chemicals included, improved physical condition of solid materials, quicker and cheaper bulk handling methods for solids, easier manufacture of liquid mix products, and more foolproof and economical handling materials and methods. We can say that our industry is certainly among the most dynamic among the chemical industries today."

TURN BACK

To page 14 if you are interested in a doctor's view of what constitutes "Accident Proneness." Dr. F. L. Foulger, Du Pont Co., discusses subject.

CALENDAR FOR 1959-60

FEBRUARY							MARCH							APRIL							MAY						
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West Coast Observer Sees Big Expansion For Fertilizer Technology in Years Ahead

LOS ANGELES—"The dynamic nature of our business can be demonstrated by noting how fast developments have come in fertilizer technology," said R. L. Luckhardt, supervisor of agricultural technical service for Collier Carbon and Chemical Corp., at the recent meeting of the California Fertilizer Assn. "For instance," he went on, "in the preparation of the text for the third edition of the Western Fertilizer Handbook, there will be a number of new materials listed which were not present on the Western market at the time of the last edition."

"One can get a concrete example of the rate of change in our fertilizer technology by looking at the liquid mix business within the last ten years. Just ten years ago when a shipment of liquid mixed fertilizer was prepared for use in the Central San Joaquin Valley, it was shipped from Santa Ana by truck. This truck carried 80 wooden barrels of 30 gal. capacity each. Now, ten years later, liquid mixes are prepared at many dealerships scattered throughout the state. These dealerships, in their most simple and economical method of operation, are really blending plants. The dealer may have two or three basic solutions in storage. These are hooked together with appropriate piping, a pump, and a meter. By metering out the correct amounts of the blending solutions into his nurse truck he is able to prepare a liquid mix very economically and quickly. Thus we have in one portion of our fertilizer technology an example of the rapid strides in development."

"The following nine points are made which list the trends in fertilizer technology that already are indicated, and which appear to be of importance in the future:

"1. Granulation and ammoniation

in dry mix production. Dr. Vincent Sauchelli was quoted as having said: "The most recent important development in the mixed fertilizer industry is granulation. Ammoniation follows next in rank. These two innovations have caused more radical changes in technology in this industry within the past five years than all the changes in the past years put together."

"2. The pelleting of ammonium phosphate, ammonium-nitric phosphate, and the granulation of single and treble superphosphate.

"3. The production of nitric phosphates and the by-product solution of calcium ammonium nitrate.

"4. The western production of urea, urea solutions, and urea-ammonium nitrate solutions containing 32% nitrogen.

"5. Liquid mix blending for local operations as mentioned above.

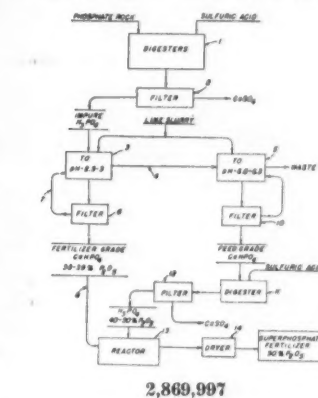
"6. The addition of minor elements and other chemicals. Sulfur is of considerable interest as an additive to fertilizers.

"7. Superphosphoric acid, although not currently being produced on the West Coast, has definite possibilities. Mixes made with green phosphoric acid are being made in the Northwest, and seem likely to be in the near future more widespread in their availability.

"8. Bulk handling of solids, particularly those contained in phosphate, seems definitely to be a development that will expand.

"9. Corrosion control in the handling of liquids seems definitely to be on the increase. It seems likely that corrosion of ammonium nitrate solution, 41% solution, and phosphoric acid will be available within a short time.

"In summary we will continue to find a wider variety of materials to



um phosphate, separating the resulting precipitate, adding lime to the remaining phosphoric acid until a pH of about 4.8-6.3 is attained and thereby producing a precipitate of more highly purified dicalcium phosphate, separating the second precipitate, digesting a quantity of the second precipitate approximately equal in dicalcium phosphate content to that of the first precipitate with sulfuric acid of a strength such as to produce directly an aqueous phosphoric acid of about 40-50% P_2O_5 content, and reacting the phosphoric acid so obtained with said first precipitate to produce a superphosphate fertilizer.

LETTERS

Continued from page 23

ternational Minerals & Chemical Corp., Skokie, Ill.

"Congratulations on your first copy of the Production Edition of Croplife. You have done a masterful job in compiling information of interest and value to plant production people. I cannot help but feel that this innovation will meet with great success..."—Edwin C. Kapusta, technical service director, U.S. Potash Co., New York.

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Classified advertisements accepted until Tuesday each week for the issue of the following Monday.

Rates: 15¢ per word; minimum charge \$2.25. Situations wanted, 10¢ a word; \$1.50 minimum. Count six words of signature, whether for direct reply or keyed care this office. If advertisement is keyed, care of this office, 20¢ per insertion additional charged for forwarding replies. Commercial advertising not accepted in classified advertising department. Display advertising accepted for insertion at minimum rate of \$11 per column inch. All Want Ads cash with order.

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FERTILIZER SALES MANAGER — Established multi-plant fertilizer company, central states area, wishes to employ man 30 to 45 who has fertilizer sales experience for position of plant sales manager. Send background resume with recent photograph. All information confidential. Address Ad No. 4601, Croplife, Minneapolis 40, Minn.

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Monsanto Chemical Company

800 North Lindberg Boulevard
St. Louis 66, Missouri
Attention: J. E. Russell

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